# CIVIL ENGINEERING

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

**GIRDER GOES UP FOR MANAHAWKIN BAY BRIDGE**

**. . . See article by Petersen**

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# SERVICE EVERYWHERE ON FOUNDATION CONSTRUCTION PROBLEMS

**Major projects of Spencer, White & Prentis include:**

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Underpinning

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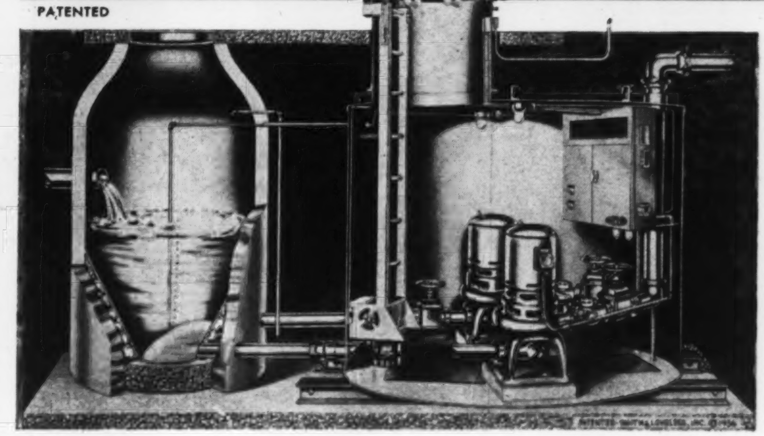

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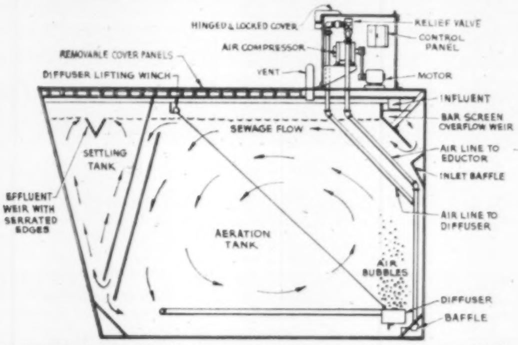

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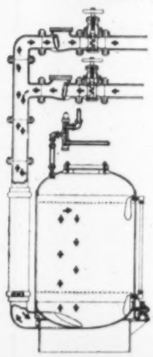

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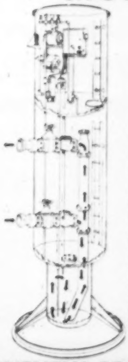
**SEWAGE EJECTOR**

Ideal for installations requiring 200 G.P.M. or less. The "Way-O-Matic" Ejector practically eliminates maintenance as the sewage does not come into contact with any of the controls. Built of finest materials to provide maximum performance at factory-built prices. The "Way-o-matic" may be ordered as a separate unit or in a complete lift station. Cutaway drawing shows operating principle.

***Smith & Loveless* "MON-O-JECT"**



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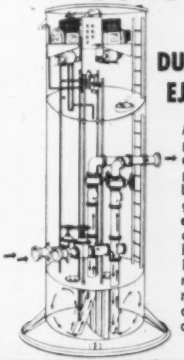
***Smith & Loveless* "DU-O-JECT"**



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For job recommendations, complete specifications, dimension drawings, capacity charts, etc., all part of the latest Smith & Loveless lift station data manual.

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No obligation.

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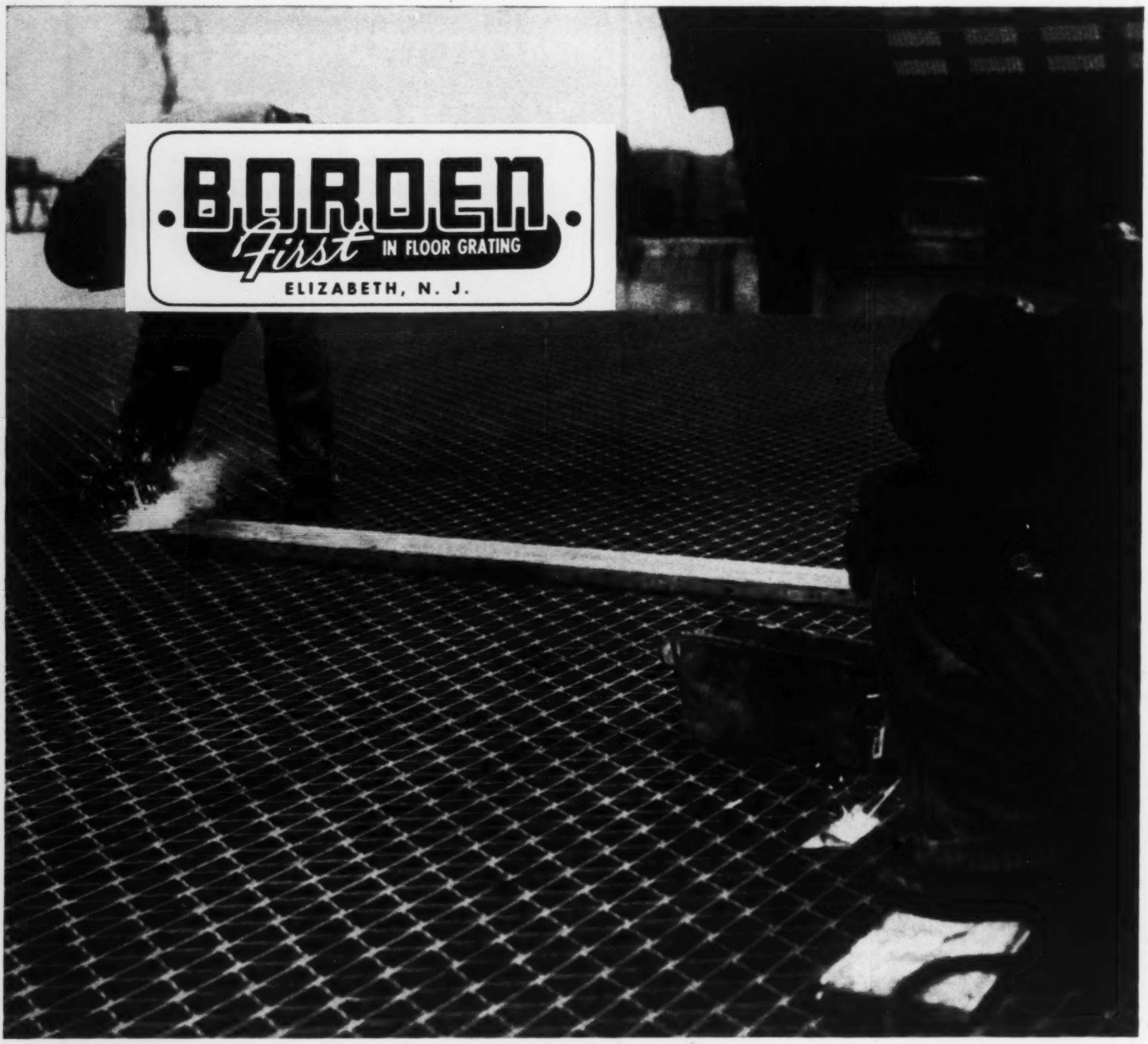

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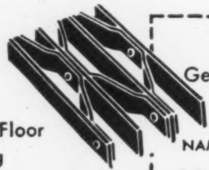

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# CIVIL ENGINEERING

AUGUST 1958
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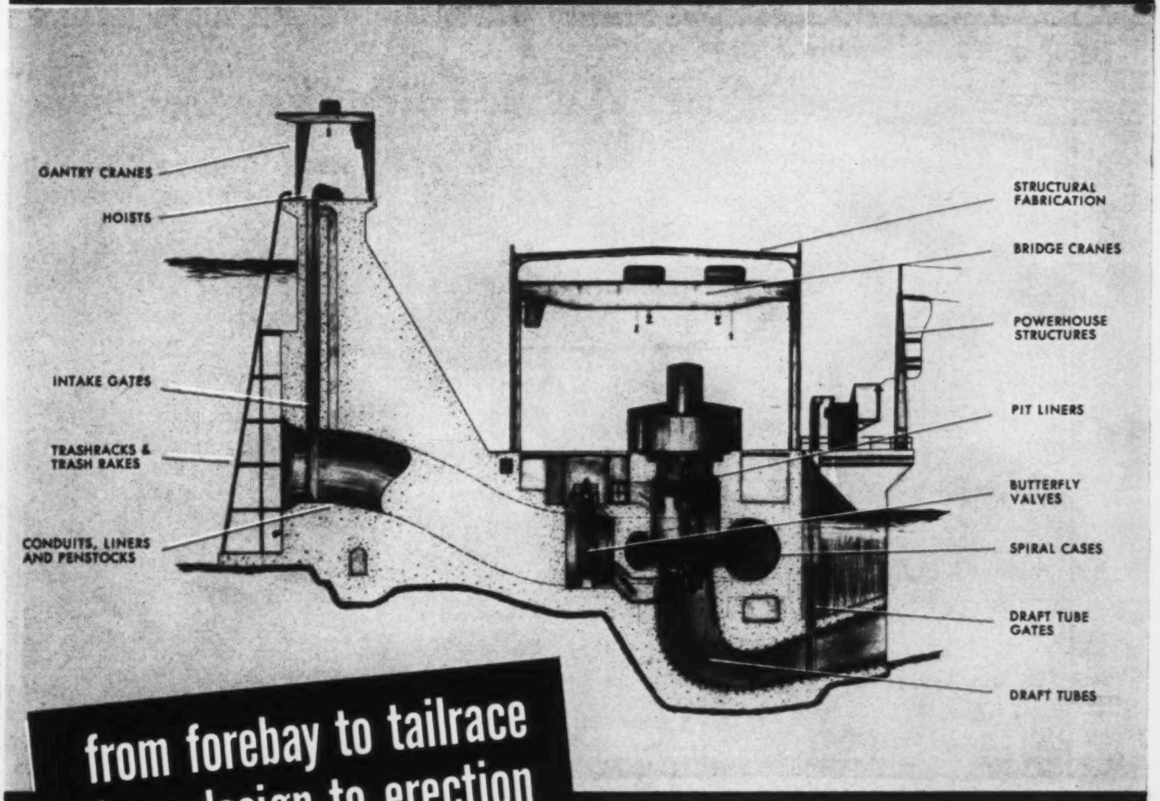
# HYDRO EQUIPMENT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DRAFT TUBES
from forebay to tailrace
—from design to erection

## BY YUBA

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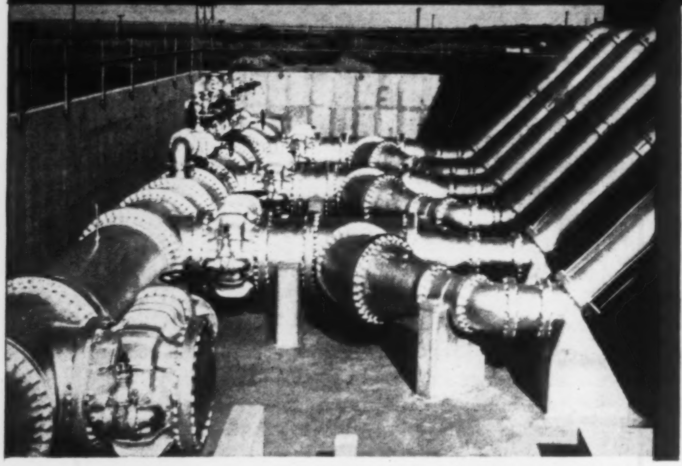
# STRENGTH PLUS



*Chicago, Ill.*—Cast Iron Pipe for installation of new water main under West Madison Street.

**THE MAN WHO CHOOSES CAST IRON PIPE TODAY WON'T PAY FOR IT AGAIN TOMORROW!**

®
CAST IRON

*Corpus Christi, Texas*—Cast Iron Pipe installation in filtration plant showing 48" discharge manifold which is connected to 48" Cast Iron city supply line.

Cast Iron Pipe Research Association
Thos. F. Wolfe, Managing Director
Suite 3440, Prudential Plaza, Chicago 1, Ill.

**MODERNIZED cast iron**

# HIGH FLOW

## You get BOTH with CAST IRON PIPE

### *Here's the proof of flow

FLOW FACTORS FOR CEMENT LINED CAST IRON PIPE

| LOCATION | SIZE | TEST SECT. IN FEET | VELOCITY F.P.S. | AGE YEARS | W & H "C" FACTOR |
|---|---|---|---|---|---|
| Bowling Green, Ohio | 20" | 45,592 | 0.7-2.4 | New | 142.5 |
| Chicago, Illinois | 36" | 7,200 | 2.6-3.6 | New | 147 |
| New Orleans, La. | 12" | 39,650 | 1.2-2.9 | New | 141 |
| Corder, Mo. | 8" | 21,350 | 0.9-2.3 | New | 143 |
| Univ. of Illinois | 8" | 400 | 3.14 | New | 150 |
| Concord, New Hamp. | 14" | 500 | 1.7-2.2 | New | 151 |
| Concord, New Hamp. | 12" | 500 | 2.0-3.4 | 11 | 142 |
| West Palm Beach, Fla. | 12" | 500 | 3.6-5.4 | 15 | 139.5 |
| Greenville, S. C. | 30" | 87,376 | 2.4-2.7 | 12 | 148.5 |
| Corpus Christi, Tex. | 30" | 65,641 | 1.1-1.8 | 6 | 146 |
| Summerville, S. C. | 8" | 500 | 1.98-2.43 | 13 | 142.5 |
| Champaign, Illinois | 16" | 3,920 | 3.1-5.6 | 22 | 139.3 |

*Available upon request: Booklet containing flow test and tables on Cast Iron Pipe.

### Here's the proof of strength

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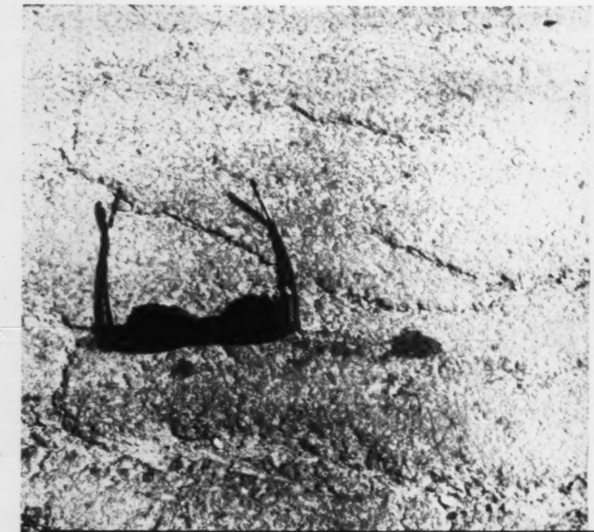
*Based on independent laboratory tests.

**pipe** FOR MODERN WATER WORKS



LEFT: A typical section of pavement to be treated with Bitumuls Slurry Seal in Rochester. RIGHT: The same pavement section after treatment with Bitumuls Slurry Seal. (Note how the crack in the foreground has been sealed).

# BITUMULS SLURRY SEALS ARE REAL LIFE SAVERS*

## *For Pavements in Rochester, New York*

FIVE FLAVOR
LIFE SAVERS

*By permission of Beech-Nut Life Savers, Inc., for candies

The City of Rochester, New York, was faced with a problem common to many communities today: keep all streets maintained in serviceable condition; yet do it at a cost that will permit the complete replacement (out of Maintenance Department funds) of many miles of streets that are over-aged.

**Problem:** How can you keep overall maintenance costs low enough to permit planned replacement of certain streets?

**Answer:** Bitumuls Slurry Sealing . . . a "life saving" technique for keeping distressed pavements in "good working order". Streets that were badly oxidized, cracked and open-textured due to a combination of age, heavy traffic, and winter weather were readily rejuvenated by the sealing, crack-filling and void-filling properties of Bitumuls® emulsified asphalt slurry.

Bitumuls Slurry Seals actually provided a holding action against wear and weather at extremely low cost. Savings over former methods were pronounced because very-costly winter patching of chuckholes was completely eliminated. As a result, expenditures for repair and control of winter damage were **reduced by almost seventy percent!** The money thus saved was diverted to reconstruction of streets that were beyond maintenance or repair.

Bitumuls Slurry Sealing is normally . . . and should be . . . regarded as only a **temporary treatment** for distressed pavements. Adequate repairs or pavement-replacement must eventually be made. Yet it is truly a "Life Saver", since it seals, protects and preserves any basically sound pavement against further deterioration until such a time as major repairs can be made, or the pavement can be replaced.

Typical view of the high-speed, high-efficiency Bitumuls Slurry Sealing in Rochester.

Your community, too, can benefit from the use of Bitumuls Slurry Seals. For further information on Slurry Sealing . . . or for the complete Bitumuls/Life Saver story . . . call our nearest office.

BITUMULS
ROADS ARE REAL LIFE SAVERS
FIVE FLAVOR
LIFE SAVERS

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Atlanta 8, Ga.
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Tucson, Ariz.
Portland 8, Ore.
Oakland 1, Calif.
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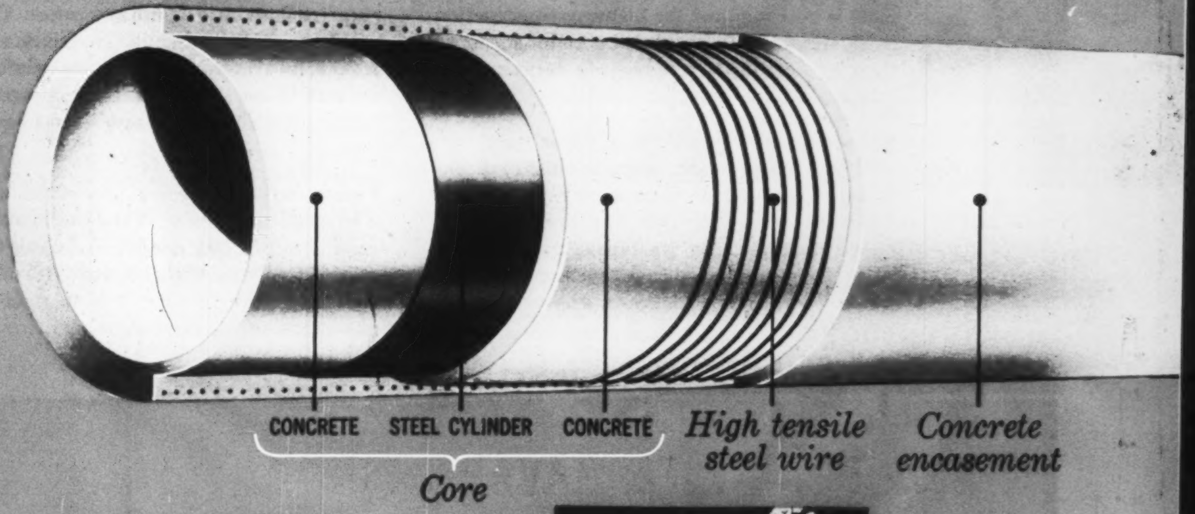
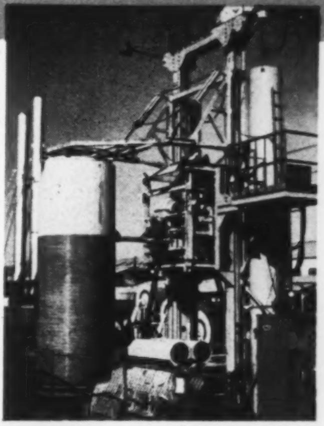
San Juan 23, P. R.

# PRESTRESSED
# CONCRETE CYLINDER PIPE
## (Embedded Cylinder Type)

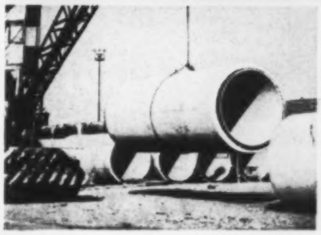
***with Rubber Gasket Joint***



All of the good qualities and characteristics desired by water works engineers for permanent water supply and transmission lines are embodied in this prestressed pipe of advanced design: great strength, sustained high carrying capacity, trouble-free service, and unusually long life. Prestressed pipe of this type can be designed more accurately, predictably and economically for most all conditions of internal pressure and external loads than any other type of high quality concrete pressure pipe. It is the finest quality pipe available in medium and large diameters for pressures generally ranging from 100 psi upward. American is currently undertaking the manufacture of this pipe designed for pressures ranging from 275 to 550 ft. of head for a portion of the U.S. Bureau of Reclamation Project being constructed for the Ventura River Municipal Water District. This Ventura River Project will serve 32 square miles of mountainous country with water for irrigation, municipal and industrial use in main and coastal reaches of Ventura County, California. When planning *your* future water "growth lines," look to American's quality pipe line products, extensive production facilities and half century of experience.



*Prestressing machine wrap's high tensile steel wire under carefully measured tension around pipe core.*



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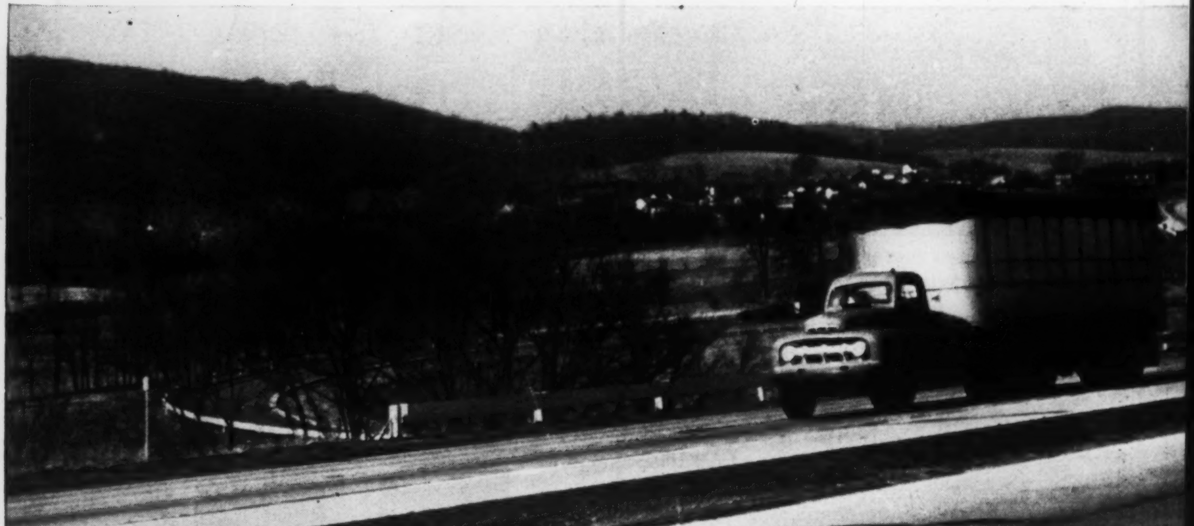
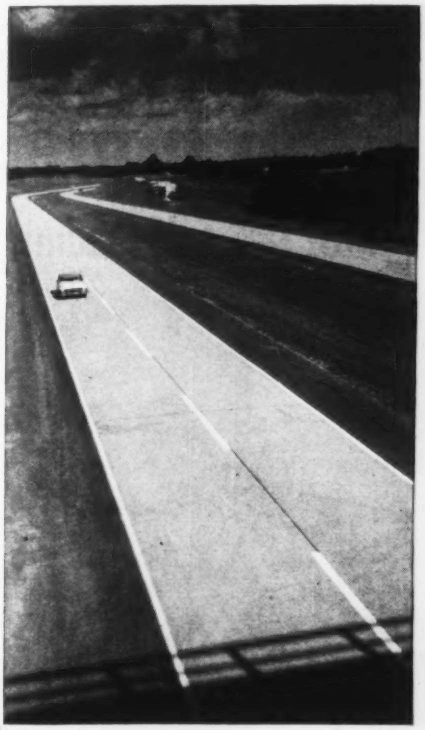


ALWAYS ASK, *"is it Reinforced"*

**USS American Welded Wire Fabric**

# reinforced with steel !



## HERE'S THE BRAND TO BUY:

**American Welded Wire Fabric** is made of *extra-strong* cold-drawn wire, electrically welded into a tough network of steel. Spacing is precise; joints are strong; and the product is rigidly inspected . . . quality-controlled from steel to finished fabric. Be sure your roads are built to last with American Welded Wire Fabric reinforcement. Send today for our new booklet: American Steel & Wire, Rockefeller Building, Cleveland 13, Ohio.

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**THE INDIANA TOLL ROAD** is *permanently* reinforced with American Welded Wire Fabric. American Welded Wire Fabric provides safety and long, dependable service for most of our other superhighways, too, including the Pennsylvania Turnpike, the New York Thru Way, the Ohio Turnpike, and the new Connecticut Expressway.

**STEEL REINFORCEMENT** is an important construction feature in most of America's new toll highways. American Welded Wire Fabric adds 30% to the strength of concrete slabs . . . provides permanent crack resistance . . . reduces the need for maintenance. And it's prefabricated for quick, easy installation. Whether you're building a turnpike or a city street, specify the finest in steel reinforcement—American Welded Wire Fabric.

**American Steel & Wire**
**Division of** USS **United States Steel**

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors • Tennessee Coal & Iron Division, Fairfield, Ala., Southern Distributors • United States Steel Export Company, Distributors Abroad

# He moves big yardage on housing development

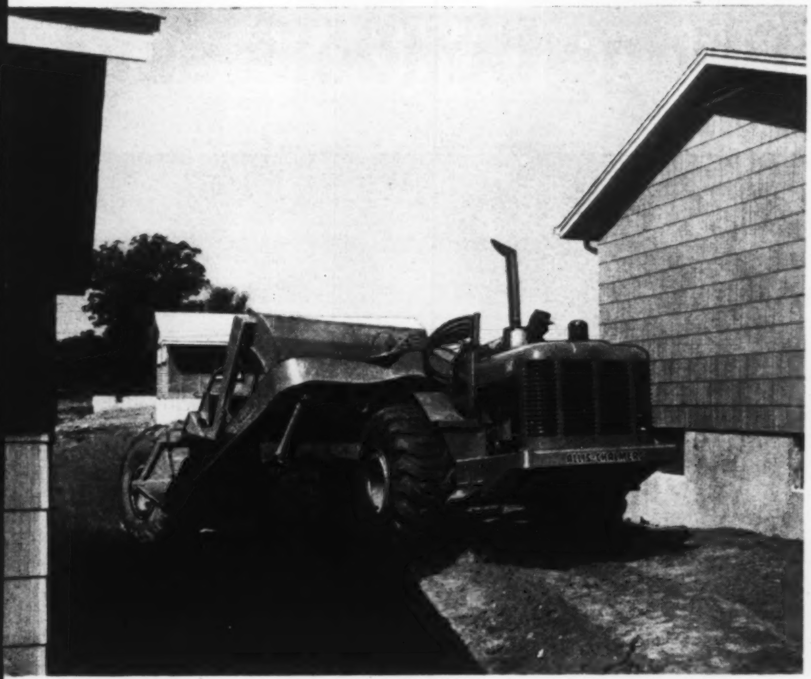
## with two self-loading 7-yd Allis-Chalmers motor scrapers . . . hauling 1,500 to 3,000 feet

*K. L. Perry*
*K. L. Perry Excavating Co.*

On a new development location for a big residential subdivision, K. L. Perry Excavating Company of Kansas City, Missouri, has found a new and profitable earth-moving team—two Allis-Chalmers TS-160 motor scrapers. Perry bought them on the basis of a demonstration which proved their maneuverability, speed and ability to self-load. Now the TS-160's have sold him on dependability and economy, too.

One of Perry's self-loaded TS-160's leaves the cut as the other returns to keep up the 1,000-yard-a-day pace on Vineyard Woods job.

# Look ahead... *move ahead*...and stay ahead with



Short turning radius (less than 25 ft) and positive hydraulic control make maneuvering through tight spots a simple operation for Perry's TS-160's.

The TS-160 is the only motor scraper near its size available with forced ejection and extra high apron lift that assures easy ejection of toughest material.

**ALLIS-CHALMERS** A-C

## TS-160's move dirt faster . . . cut operating costs in half

Earth-moving operations in modern housing developments have to move fast to keep costs low . . . and to set the pace for production line methods in home construction. On the Vineyard Woods job, for instance, to maintain the building program, Perry had to average 500 cubic yards per day, hauling up to 3,000 feet.

His two Allis-Chalmers TS-160 motor scrapers handled it with plenty to spare. Self-loading, they frequently topped 1,000-yard production daily. At the same time, operating costs were cut in half compared to his previous equipment. Perry says his Allis-Chalmers motor scrapers are big producers . . . helped him finish contracts days ahead of schedule. He now bids and makes a profit on contracts he couldn't consider before.

## Self-loading, compactness and maneuverability make TS-160's naturals for development work

Primary factors in Perry's choice of Allis-Chalmers TS-160's were their demonstrated high-speed and self-loading ability. However, since he's had them, other benefits have become apparent. Perry is particularly pleased with their maneuverability. They turn in less than 25 feet—a valuable timesaver in limited space on many housing development operations. Hydraulic power steering makes maneuvering in tight quarters easy and efficient.

They also save time and money between jobs . . . move on highway at up to 25.4 mph. Operator comfort and ease of handling were noted as outstanding by Perry and his crew.

## Performance sold the machines . . . dependability proved their value

K. L. Perry checked them all when he was in the market for high-speed dirt-moving equipment. He says, "We were sold by demonstration that the Allis-Chalmers machines were best—but the real proof came with performance like we had on the Vineyard Woods development in Kansas City. We've had only routine maintenance on the machines in eight months since we bought them. They put us in position to get the 500-home Kentucky Hill job at Independence, Missouri."

This TS-160 motor scraper story is a good example of the value in talking things over with your Allis-Chalmers construction machinery dealer. He knows the earth-moving business and can help you choose the machines that will help you most. Ask him for a demonstration right on your job. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

# Bridge builders save

KEEP OUR
ROADS
ON THE GO

These twin, continuous deck roadways span 2306′ across the Kaw River, on 4310 tons of USS TRI-TEN Steel and structural carbon steel.

# $100,000 with USS Tri-Ten Steel

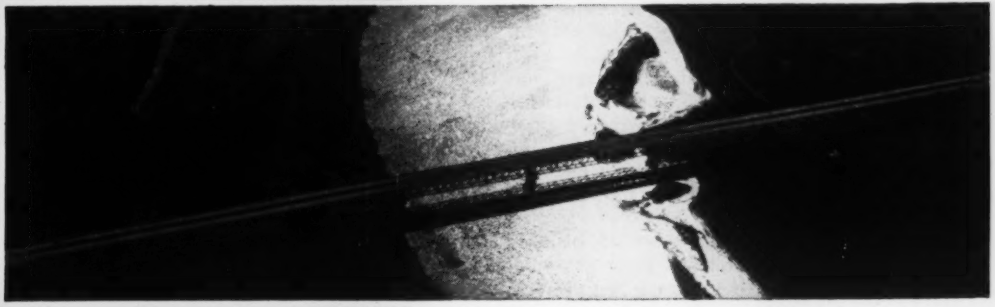
## in the Kansas Turnpike's biggest bridge

THIS BRIDGE would have weighed 4,810 tons if it had been built entirely from structural carbon steel. Instead, the designers used USS TRI-TEN Steel for the more heavily stressed chords and diagonals. Because of the stronger steel, these parts could be made thinner, and lighter—*500 tons lighter,* with an estimated saving of *$100,000* in total steel costs.

TRI-TEN Steel members can be made lighter with no loss of strength because TRI-TEN Steel has a much higher yield point than carbon steel—50% higher in thicknesses of ¾" and less—and it meets fully all of the requirements of ASTM Specification A242 for High-Strength Low-Alloy Steels. Because lighter members can be used, dead weight can be reduced as much as 20%, freight costs are lower, and construction is easier.

For more information about construction for maximum strength and minimum weight with USS High Strength Steels—TRI-TEN, COR-TEN, and MAN-TEN—write for a copy of *"Design Manual for High Strength Steels,"* United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

*USS, Cor-Ten, Man-Ten and Tri-Ten are registered trademarks*

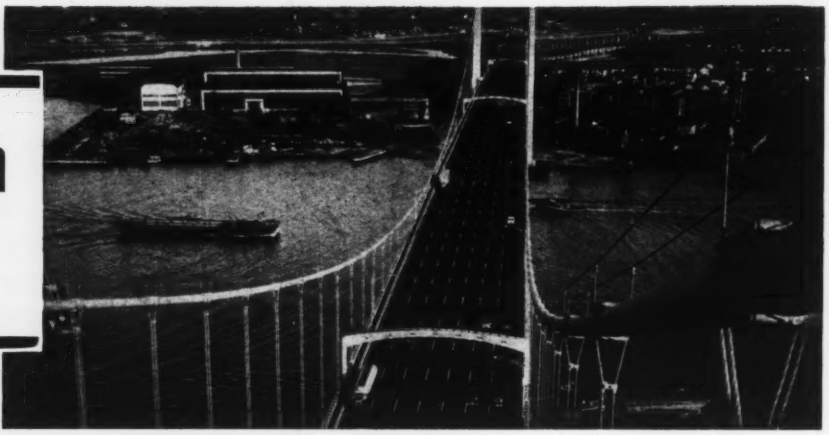


**Fisher Memorial Bridge, Lawrence, Kansas**
Owner—Kansas Turnpike Authority
Designer—Howard, Needles, Tammen & Bergendoff
Fabricator—Kansas City Structural Steel Co.
Erector—John F. Beasley Construction Co.

United States Steel Corporation – Pittsburgh
American Steel & Wire – Cleveland
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
United States Steel Supply – Steel Service Centers
United States Steel Export Company

USS **United States Steel**

(Photo courtesy Lukens Steel Co., Coatesville, Pa.)



# Walt Whitman Bridge

Texaco Asphaltic Concrete paving on this new bridge across the Delaware River at Philadelphia serves 30,000 vehicles a day.

## Both needed heavy-duty paving—
## *both* are served by Texaco Asphaltic Concrete

# Massachusetts Turnpike

27 miles of this heavily-traveled toll road are paved with a Texaco Asphaltic Concrete surface on an asphalt foundation.

Traffic on these important new arteries is typical in volume and weight of that anticipated on the projected Interstate Highway System.

Hot-mix Texaco Asphaltic Concrete on the Walt Whitman Bridge and the Massachusetts Turnpike again demonstrates its rugged durability under heavy traffic loads. Its performance on such arteries as these strongly recommends this resilient, easy-riding, economical paving for Interstate routes.

Regardless of how the cost of highways is divided between Federal and State governments, the taxpayer foots the entire bill. Consideration for his pocketbook calls for sound economy in highway design. Hot-mix Texaco Asphaltic Concrete paving, in addition to its ability to absorb punishing impact, costs substantially less than rigid paving. Consequently, it helps the road builder get more mileage out of available highway dollars.

Other advantages of hot-mix Texaco Asphaltic Concrete include the speed with which it is laid and opened to traffic, its immunity to ice-control salts, its skid-resistant texture, freedom from glare and the sharp visibility of traffic lines on its dark surface.

Helpful information for the road builder on all types of Asphalt construction, including hot-mix Asphaltic Concrete, is supplied in two free Texaco booklets. Copies can be obtained without obligation by writing our nearest office.

THE TEXAS COMPANY, Asphalt Sales Div., 135 E. 42nd Street, New York City 17
**Boston 16 • Chicago 4 • Denver 1 • Houston 1 • Jacksonville 1 • Minneapolis 3 • Philadelphia 2 • Richmond 11**

# TEXACO ASPHALT

THE
Foundations
STORY
. . . BUY "JAY"

Never before has so much depended on so little as in today's costly and competitive construction market. Modern buildings are taller, heavier, and far more expensive than ever before, and "JAY" Tampers are specifically designed to deliver compaction when and where it counts in building construction. Built by the compaction pioneers who put "quality first" the "JAY" has proven itself from Maine to California, from Florida to Alaska and in 29 foreign countries. For the firm foundations of tomorrow, see your "JAY" dealer today.

THE "JAY" Company

See your "JAY" dealer today or write to . . .

2222 S. Third St., Columbus 7, Ohio

Please send me additional information on the "JAY" TAMPER

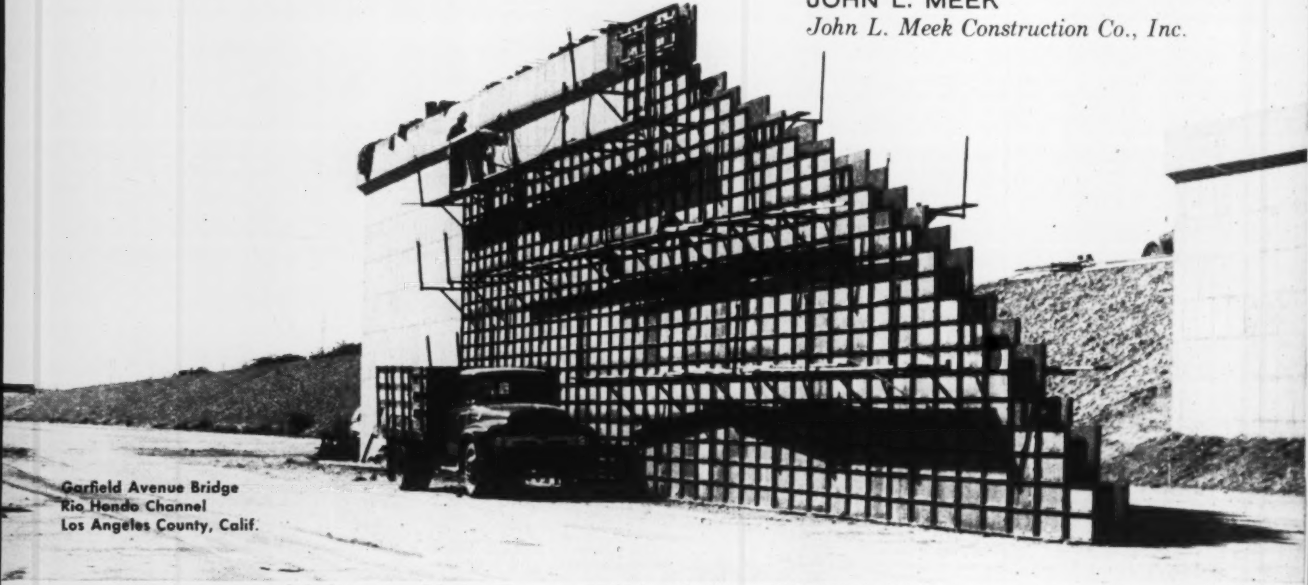
My name ______________________________

Street ______________________________

City ______________________ Zone ________ State ________

# "my men were UNI-FORM EXPERTS an hour after they began using them"

JOHN L. MEEK
*John L. Meek Construction Co., Inc.*



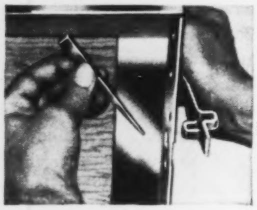
**Garfield Avenue Bridge**
**Rio Hondo Channel**
**Los Angeles County, Calif.**

**Stripping center of 3 piers. Piers were 26' high, with 40" cap. UNI-FORM Scaffold Brackets attach to steel frame of UNI-FORMS.**

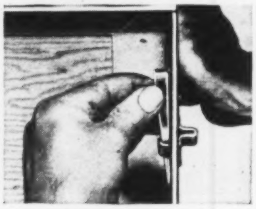
When inexperienced crews—men who have never used them before—can become expert in the handling and erection of UNI-FORM Panels in an hour or two, it means big savings in time and labor . . . faster job progress and lower all around costs. Simple mechanical assembly of UNI-FORM Panels permits fewer men to form more contact area per hour than is possible with any other job-erected forming system. The John L. Meek Construction Company's experience with UNI-FORM Panels is typical—quick mastery of the simple UNI-FORMING technique, resulting in faster forming with less labor. A good reason why more concrete is being formed every day with UNI-FORM Panels . . . why more contractors are using the UNI-FORM System for all their forming, regardless of type and size of the job. Write for the UNI-FORM Catalog—illustrates and describes the complete UNI-FORM System.

**Pier and wing wall is 122' long. Tapered wing walls cut flow pressure.**

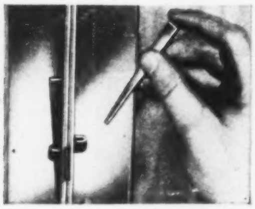
## UNI-FORM ASSEMBLY IS SIMPLE AS THIS:



**1. UNI-FORM Tie Loop is placed into the square tie hole of Panel.**



**2. Tie Key is set into the Tie loop. This locks tie and Panel into 1 unit.**



**3. Bring next UNI-FORM Panel into position. Insert Tie Key in other Tie loop. Assembly is completed.**

## UNIVERSAL FORM CLAMP CO.

**1238 N. KOSTNER • CHICAGO 51, ILLINOIS**

**CONCRETE FORM SPECIALISTS SINCE 1912**

**BRANCH OFFICES AND WAREHOUSES**

SAN LEANDRO, CAL.
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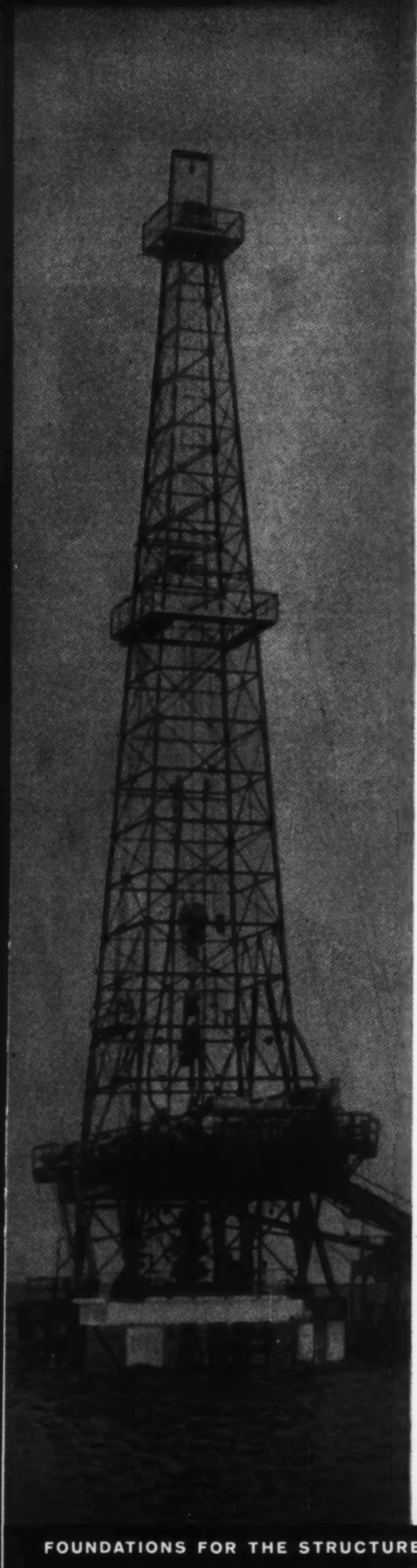
CLEVELAND, OHIO
24901 Lakeland Blvd.

ATLANTA, GEORGIA
1401 Howell Mill Rd., N.W.

Universal Form Clamp Co. of Canada, Ltd., 226 Norseman St., Toronto, Ontario



# RAYMOND

## to erect 50 offshore derrick platforms for

# MENE GRANDE

## OIL COMPANY

Mene Grande Oil Company awarded Raymond* this important contract, covering a 2 year period, because of the impressive results of Raymond's Prestressed Concrete Cylinder Piles.

A pioneer in Venezuelan oil development, Mene Grande is all too familiar with the particular problems encountered in offshore drilling in Lake Maracaibo. The lake's water is highly corrosive, and, in addition, the area is struck frequently by raging windstorms called *chubascos*. Not only are Raymond Prestressed Cylinder Piles impervious to damage by marine life and aggressive water, but they also offer greater structural strength, increased load capacities and longer life. Another factor which was important in Mene Grande's decision, is that Raymond Prestressed Cylinder Piles are manufactured right at the job site . . . providing a substantial saving in both time and money.

Raymond is proud of its role in assisting the oil industry over the past 50 years—also for its part in aiding the economy of Venezuela since 1926 when Raymond opened its office in this abundant country. You'll find Raymond foundations supporting offshore oil drilling rigs, tanker wharves, cat-crackers and storage tanks just about everywhere oil is drilled and refined. May we also serve you?

**In a joint venture with Brown & Root.*

**RAYMOND**
**INTERNATIONAL INC.**

**140 CEDAR STREET, NEW YORK 6, N.Y.**
*Branch Offices in Principal Cities of the United States; Subsidiaries in Canada, Central and South America and other countries.*

**FOUNDATIONS FOR THE STRUCTURES OF AMERICA · COMPLETE CONSTRUCTION SERVICES ABROAD**

# NEWS OF ENGINEERS

**K. E. Fields** has retired as general manager of the Atomic Energy Commission, Washington, D. C. General Fields has been with the Commission for about ten years and has served as general manager since 1955.

**Joseph A. Bacci** has been named resident engineer for the new Remote Facilities Field Project of the U. S. Army Engineer District in Alaska. Major Bacci has done a considerable amount of work with the Army's development of atomic power and nuclear reactors. He will take over certain deactivated project offices and the supervision and inspection branch of the Division's construction division.

J. A. Bacci

**Thomas R. Glenn, Jr.,** has been appointed director and chief engineer with the Interstate Sanitation Commission. For the past two years, Mr. Glenn has been assistant chief engineer.

**Alfred C. Scheer,** formerly of the South Dakota School of Mines and Technology, has joined the faculty at Montana State College as associate professor of civil engineering. Professor Scheer is planning the expansion of the graduate and research programs in highway engineering and soil mechanics at Montana State.

**Edmund H. Lang,** Colonel, Corps of Engineers, and district engineer, U. S. Lake Survey, Detroit, Mich., has been named director of the Waterways Experiment Station at Vicksburg, Miss. A veteran of World War II, Colonel Lang has taught at the Army's Engineer School and Pennsylvania State College. He received his master's degree in civil engineering from the latter school. Colonel Lang succeeds Col. Andre P. Rollins, Jr., director of the station since 1955. Colonel Rollins has been assigned to the Army War College at Carlisle Barracks, Pa.

**B. K. Hough** has resigned as professor of civil engineering at Cornell University after a career of over ten years with the university. Professor Hough plans to remain in Ithaca, N. Y., and to practice soils engineering.

**Zachary Sherman,** consulting engineer, announces the opening of an office for the practice of professional engineering in Memphis, Tenn., at 3387 Poplar Avenue. The firm will specialize in the design of heavy structures. A "Contractor's Advisory Service" will also be offered for methods of excavation, sheeting and bracing for deep excavations, concrete formwork, underpinning, dewatering, inspection and supervision of construction. For the past four years, Mr. Sherman has been engaged as consultant to engineers and industrial firms in the Mid-South area.

Zachary Sherman

**Nathan W. Dougherty,** retired dean of the College of Engineering at the University of Tennessee, has been named the third honorary member of the American Society for Engineering Education. Dean Dougherty was honored in recognition of his "eminent service to mankind in engineering education. . . ."

---

HOW LONG IS A LONGSPAN JOIST?

HAVEN-BUSCH Company
SINCE 1888

DESIGNERS — FABRICATORS — ERECTORS

T-Chord* Longspan Joists Structural Steel
Miscellaneous Iron

3445 CHICAGO DRIVE, S.W.—GRANDVILLE, MICH.
PHONE: LEnox 2-3641

*T.M. Reg.

**The longest structural steel joist** made is a 150 foot T-Chord* Longspan Joist produced exclusively by Haven-Busch Company. While most other joists run less than 100 feet in length, Haven-Busch makes this extra long joist (half the length of a football field) to give architects and builders greater leeway in planning large clearspan, column-free interiors for such buildings as a bowling alley, fieldhouse, gymnasium or auditorium.
It is because of products such as this 150 foot long joist — and the men who make it — *that better building begins with steel by Haven-Busch.*

**John A. Logan** has been named chairman of the department of civil engineering at the Northwestern University Technological Institute, Evanston, Ill. He has served as professor at Northwestern since 1954. He holds master's and doctor's degrees from Harvard University.

**Dewey S. Wright** has moved to Helena, Mont., where he will be an executive of the Elk River Concrete Products Company of Montana. Formerly Mr. Wright was city engineer of Denver, Colo. His new office will be at Room 502, Power Block, in Helena.

**Ervin Greenbaum,** consulting engineer of Detroit, Mich., was in command of the Fifth U. S. Army Infantry Reserve School at Ft. Riley, Kans., during June. The training emphasized concepts in modern warfare, the new pentomic division organization and defense against nuclear weapons.

**E. A. Miller** has been elected to the Board of Directors of Fenestra, Incorporated, Detroit, Mich. Mr. Miller has been with the company since 1943, and is vice president of the Building Products Division.

**S. B. Lincoln**

**Samuel B. Lincoln,** president and director of Lockwood Greene Engineers, Inc., in New York City, recently received the honorary degree of Doctor of Engineering from the University of Maine. Mr. Lincoln, an alumnus of the university, was cited in part for "ability as an engineer and . . . success as administrator of a large organization. . . ."

**Dwight H. Bray** has been chosen as the new president of the Mississippi Valley Conference of State Highway Departments. Mr. Bray will continue to hold the post of state highway engineer in the Kentucky State Highway Department at Frankfort.

**B. D. Tallamy** has been made a national honorary member of Chi Epsilon, national engineering fraternity. He is the first national honorary member to be chosen in four years and is the twenty-second such member. Mr. Tallamy is Federal Highway Administrator for the U. S. Bureau of Public Roads in Washington, D. C.

**Charles Gilman,** formerly vice president of the Massey Concrete Products Company, New York City, is now serving as concrete products consultant with offices at 950 Hillside Ave., Plainfield, N. J., and 24 Commerce St., Newark. He is specializing in precast concrete building products but will continue in the promotion and production of concrete cribbing.

**THE TOP OF ITS CLASS**

**T-16 OPTICAL TRANSIT**

In any comparison of optical and mechanical precision, features and versatility, three characteristics of this repeating transit become immediately evident:

*The Wild T-16 is faster, more accurate, and much easier to work with than any other instrument in its price class.*

This is the consensus of engineers and surveyors in mining, highway and land surveying functions throughout the world.

Your own evaluation, cordially invited, will quickly prove these facts. Write for the WILD Bulletin T-16.

*Full Factory Services*

WILD HEERBRUGG INSTRUMENTS, INC.

MAIN AT COVERT STREET, PORT WASHINGTON, NEW YORK • PORT WASHINGTON 7-4843 for the purpose of placing concrete

GAR-BRO power carts rate best!

-rate them yourself!

Placing concrete is a very specialized job requiring specialized carts. They should be judged on many other factors than just mechanical features. For instance: –

GAR-BRO | OTHER MAKES

**WEIGHT IS A FACTOR!** Heavier carts require stronger and more costly runways. Gar-Bro Power-carts are lightest in their class.. 100% ....

**POWER TRANSMISSION IS VITAL!** Short hauling distances require fast "stop and go" acceleration. Simple belt-driven Gar-Bro Power-carts can do what no cart with an automotive or automatic transmission can do. They take off faster... they can reverse direction at top speed... they can take rugged handling .......................... 100% ....

**TURNING RADIUS IS IMPORTANT!** Turning ability establishes the width of runways. Gar-Bro Power-carts U-turn in a 4-foot radius – can be operated safely on a 5-foot runway..... 100% ....

**EASE OF OPERATION!** Gar-Bro Power-carts are the simplest to handle. The tiller guides and controls – you push down to go forward and pull up to reverse. No foot clutch... no gear shift... no geared transmission... no steering wheel hazard .................................. 100% ....

**COST IS A FACTOR!** Gar-Bro Power-carts cost less than any other motorized cart to buy, less to maintain.............. 100% ....

**COMPARE ALL THESE FEATURES:** 12-14 cu. ft. capacity, 15 m.p.h. speeds, 35 to 45 miles per gallon, positive controlled dumping, heavy duty Timken bearings throughout and low, low maintenance costs.
*Write for literature and information.*

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GAR-BRO *The world's most complete line of* CONCRETE HANDLING EQUIPMENT

EQUIPMENT GAR-BRO ENGINEERING SERVICE

**Henry C. Boschen** has been named for a three-year term on the Planning Commission of Scarsdale, N. Y. Mr. Boschen is vice president in charge of foreign work for the Raymond International Corporation, New York City.

**Donald M. Burmister,** professor of civil engineering at Columbia University, has received the C. A. Hogentogler Award. The award was presented in Boston at the Road Materials Industry Luncheon during the 61st Annual Meeting of the American Society for Testing Materials. Professor Burmister was honored for his paper, "Environmental Testing of Soils."

W. W. Donnan

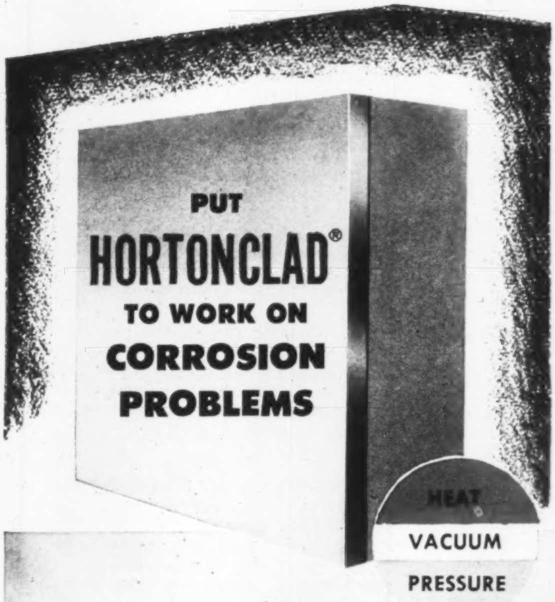
**William W. Donnan,** of West Covina, Calif., will be one of seven soil and water experts going from this country to Russia in a cultural exchange program. The group will visit experiment stations, irrigation and drainage projects. A similar delegation of Russian scientists and engineers will visit the United States with the aim of becoming acquainted with soil and water management research in the two nations. Following his Russian tour, Mr. Donnan, who is with the U.S. Department of Agriculture, Pomona, Calif., will make a study trip of drainage and reclamation projects in Denmark, the Netherlands, France, England and Scotland.

**D. B. Steinman,** New York City consultant and outstanding bridge designer, received his twentieth honorary degree at commencement exercises at St. Lawrence University this June. The university conferred upon Dr. Steinman the degree of Doctor of Humane Letters. Currently Dr. Steinman is engaged on design and construction of an intercontinental bridge over the Bosporus to join Europe and Asia.

**Clyde E. Kesler,** professor of theoretical and applied mechanics at the University of Illinois, was co-recipient with Tien S. Chang, of the Sanford E. Thompson Award at the ASTM's Road Materials Industry Luncheon on June 25. The award was established by the ASTM Committee on concrete and concrete aggregates and is given in recognition of the authors' paper, "Correlation of Sonic Properties."

**John J. Sleavin** and **Carroll L. Brown** announce their partnership in a new consulting engineering firm at 1110½ South Yakima, Tacoma, Wash. Mr. Sleavin previously has been with Sitts and Hill, a Tacoma engineering firm.

*(Continued on page 24)*

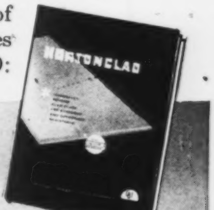


# High-Strength Bonded Clad Material Described in New CB&I Bulletin

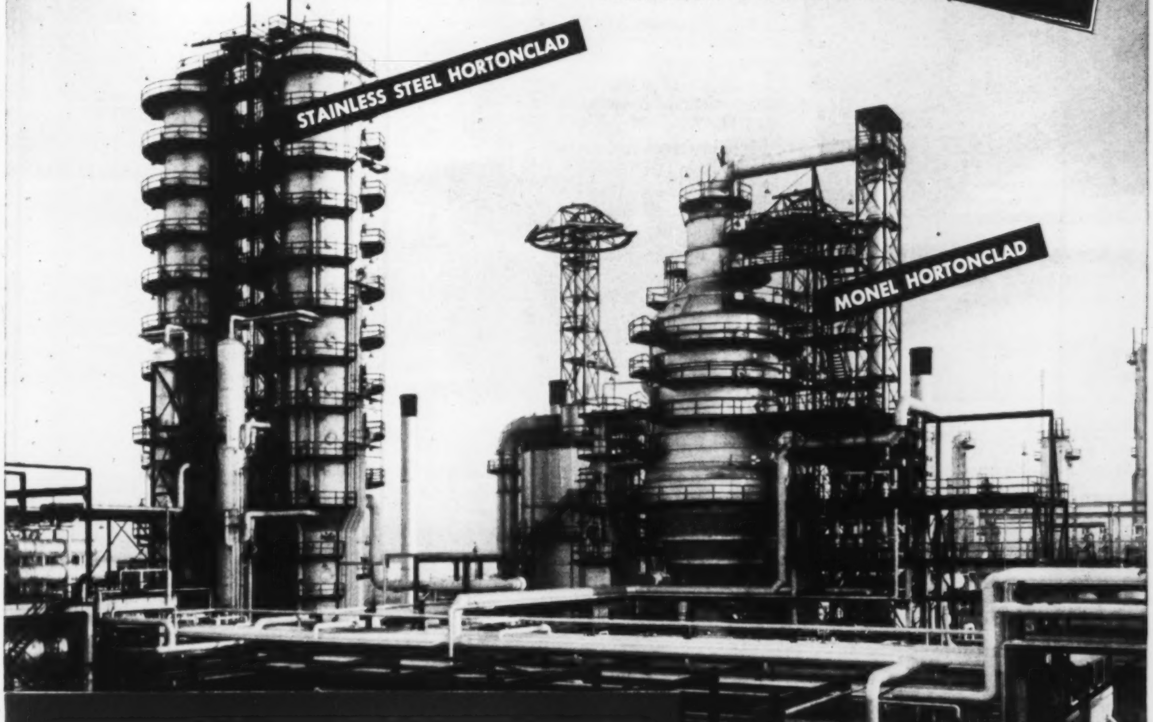
Hortonclad is a corrosion-resistant composite metal having an integral and continuous bond of exceptionally high strength produced by a special high-vacuum bonding process. Available only in CB&I-fabricated tanks, pressure vessels and other clad structures, Hortonclad provides uniform thickness because cladding and backing plate are both in their final thickness prior to bonding.

The Hortonclad process employs silver, stainless steels (both chromium and nickel) nickel and alloys such as Monel, Inconel, Hastelloys B and F and a variety of other metals and alloys.

Write our nearest office for a copy of the CB&I bulletin which describes these benefits of HORTONCLAD:



- **UNIFORM THICKNESS**
- **HIGH STRENGTH BOND**
- **CLEAN, CONTAMINANT-FREE SURFACE**
- **ADAPTABILITY TO ANY SIZE OR SHAPE**



Two crude columns (left) and vacuum column (right) were partially clad using Monel Hortonclad and stainless steel. Crude columns are 174-ft. high. Vacuum column is 28-ft. in dia. at widest point and 125-ft. high.

## Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston • Kansas City (Mo.)
New Orleans • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • South Pasadena • Tulsa
*Plants in* BIRMINGHAM, CHICAGO, SALT LAKE CITY,
GREENVILLE, PA. and at NEW CASTLE, DELAWARE.
*In Canada:* HORTON STEEL WORKS LTD., TORONTO, ONTARIO
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Chicago Bridge Limited, London; Sociedade Chibridge de Construcoes Ltda., Rio de Janeiro

CB&I

P71-C

BOILER ROOM FLOORS
MUST STAY
SAFE, CLEAN

Ashes, coal and other substances under foot often make solid floors in boiler rooms unsafe.

Such hazardous materials cannot accumulate on a floor made of Irving open steel grating. Debris falls right through, making floors always clean. Dangerous fumes can escape through open grating. Floors made of Irving Grating are clean, safe at all times . . . no ankle turning, tripping, slipping, hot foots. It is fireproof, self-ventilating.

*Manufacturers of Riveted, Pressure-Locked, and Welded Gratings of Steel, Aluminum and other metals.*

"A FITTING GRATING FOR EVERY PURPOSE"

IRVICO

IRVING SUBWAY GRATING CO., Inc.
*Originators of the Grating Industry*

Offices and Plants at
5008 27th St., LONG ISLAND CITY 1, N. Y.
1808 10th St., OAKLAND 23, CALIFORNIA

*(Continued from page 22)*

**John J. Kassner** announces the removal of the New York offices of his firm, John J. Kassner, Consulting Engineers, to 6 Church Street. The officers originally were located at 111 Broadway.

**Linton E. Grinter and Hunter Rouse** were honored at the annual meeting of the American Society for Engineering Education. Dr. Grinter was recipient of the Lamme Medal for distinguished service in engineering education. He is dean of the graduate school and director of research at the University of Florida. Dr. Rouse, director of the Institute of Hydraulic Research at the State University of Iowa, received the Vincent Bendix Award for outstanding research contributions.

**Arthur Q. Adamson** is the 1958 recipient of the Marston Medal given at Iowa State College during June commencement exercises. Prior to his retirement in 1948, Mr. Adamson was active in the building of YMCA structures all over the world. The Marston Medal is given in honor of the late Anson Marston, Past President and Honorary Member of ASCE, and long-time professor of civil engineering at Iowa State College. To be eligible for the medal, candidates must have received a degree from the college and have at least 30 years experience in engineering.

A. Q. Adamson

**Charles E. Carver, Jr.,** has taken the post of associate professor of civil engineering at the University of Massachusetts. Before joining the university faculty, Dr. Carver was with the Woods Hole Oceanographic Institution as research assistant in hydraulics. Part of his work there consisted of research on ocean waves.

**David G. Chase** has been appointed manager-secretary of the Clay Pipe Institute. Mr. Chase who previously served as sales engineer for the Blue Diamond Corporation in Los Angeles, has had experience in sanitary engineering and the construction and materials fields. He is a veteran of World War II and Korea.

**George A. Guyer** has transferred to the Internal Revenue Service in Pittsburgh, Pa., as a valuation engineer, after more than 28 years with the Pittsburgh District of the Corps of Engineers. In his most recent assignment in the Pittsburgh District, Mr. Guyer was in charge of the planning and design of Air Force projects in the Engineering Division.

**Bert R. Mullen** has retired from the U.S. Corps of Engineers after a career of 28 years in government service. A veteran of World War I, Mr. Mullen joined the Corps in 1932, resigning later to serve with the Soil Conservation Service. He has been with the Kansas City District of the Corps since 1947.

B. R. Mullen

**Marvin J. Granstrom,** associate professor of sanitary engineering in the University of North Carolina's School of Public Health, has been appointed chairman of the department. Former department chairman W. B. Snow will remain on the staff as professor of sanitary engineering.

**Walter C. Oram** has been appointed paving engineer of the Rocky Mountain Regional Office of the Portland Cement Association. Mr. Oram, who has been with the Association since 1952, has served as special assignment engineer in the Highways and Municipal Bureau and as general field engineer at the Seattle District Office.

Walter Oram

**L. E. Hunter** announces that he has opened offices under the name of L. E. Hunter and Partners at 123 Victoria Street, London S. W. 1. The firm will practice civil engineering.

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AMERICAN MILITAR

**Harold E. Bisbort, Colonel, Corps of Engineers and U. S. District Engineers, Mobile, Ala., is awarded the State of Alabama Commendation Medal for "exceptionally meritorious and distinguished military services in a position of great responsibility." Making the presentation is Maj. Gen. James F. Berry, Adjutant General of Alabama. Colonel Bisport has been reassigned to the United States European Command headquarters in France.**

## Non—ASCE Meetings

**American Bridge, Tunnel, and Turnpike Association.** Annual meeting, October 15-18, Richmond, Va., at the Hotel John Marshall. For information write J. A. Stearns, executive secretary, ABTTA, P.O. Box 148, White Plains, N. Y.

**American Institute of Chemical Engineers.** Thirty-eighth National Meeting, September 21-24, Salt Lake City, Utah, at the Hotel Utah. For information write F. M. Parker, P.O. Box 1889, Salt Lake City, Utah.

**American Public Works Association.** Public Works Congress and Equipment Show, September 28-October 1, in Kansas City, Mo., at the Municipal Auditorium and the Hotel Muehlebach. For information write the Association, 1313 E. 60th St., Chicago 37, Ill.

**Atoms for Peace.** Second International Conference on Peaceful Uses of Atomic Energy, September 1-13, Geneva, Switzerland. Details from headquarters in Geneva.

**Building Research Institute.** Conference on Installation and Maintenance of Resilient Smooth-Surface Flooring, September 17-18, Washington, D. C., at the Sheraton-Park Hotel. For information write Division of Engineering and Industrial Research, National Academy of Sciences, National Research Council, 2101 Constitution Ave., Washington 25, D. C.

**Federation of Sewage and Industrial Wastes Association.** Thirty-first Annual Meeting, October 6-9, Detroit, Mich., at the Sheraton-Cadillac Hotel. For information write Association headquarters, 4435 Wisconsin Ave., Washington 16, D. C.

**Fifth Convention of the Pan American Federation of Engineering Societies,** September 3-6, in Montreal, Canada. For information write Engineers Joint Council, 29 W. 39th St., New York 18, N. Y.

**First International Skid Prevention Conference,** September 8-12, Charlottesville, Va., at the University of Virginia. Registration material and information may be obtained from J. B. Kinker, Director of Conferences and Short Courses, University of Virginia, Charlottesville, Va.

**Illinois Chamber of Commerce.** Water Pollution Abatement Conference, August 27, Chicago, Ill., at the Sherman Hotel. For information write to the Chamber of Commerce in Chicago.

(*Continued on page 111*)

**NOW! FASTER TESTS . . . MORE TESTS . . .**

**. . . WITH THE SAME MANPOWER!**

WASHINGTON Dens-o-meter

**THE KEY TO ACCURATE FIELD TESTS FOR MOISTURE-DENSITY IN EMBANKMENT AND FOUNDATION SOILS.**

***The DENS-O-METER is light in weight, compact, very portable, easy and economical to operate and maintain!***

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- ***in small or large holes up to 3 ft. deep***
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CONTRACTORS AND ENGINEERS: Stop over-compaction, under-compaction . . . make moisture-density determinations many times daily with a DENS-O-METER.

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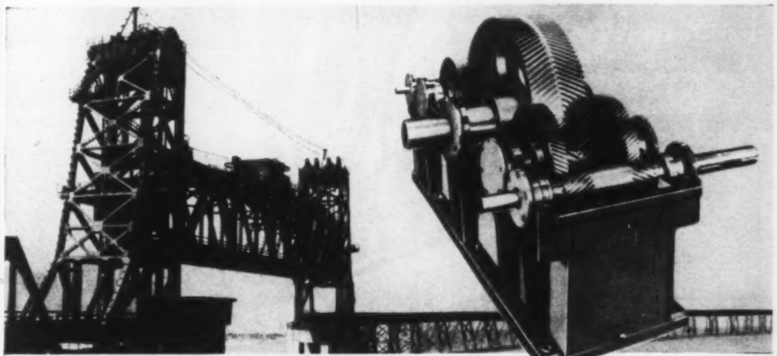

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**Owner: The New York, Chicago and St. Louis R. R. Co.**
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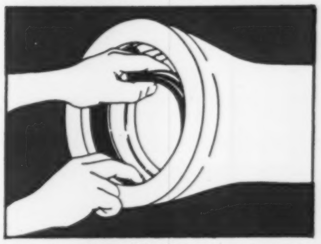
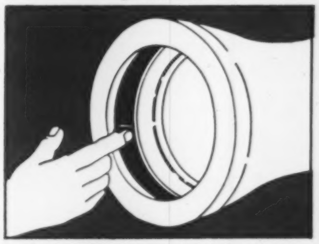
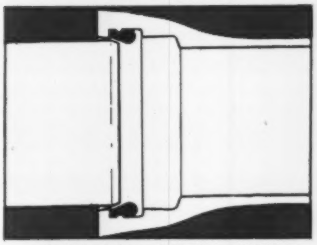
**ONLY FOUR SIMPLE ACTIONS**



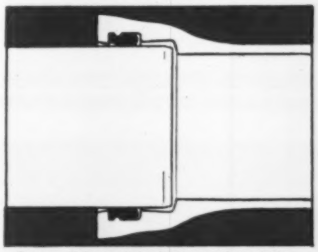
Insert gasket with groove over bead in gasket seat



Wipe a film of special lubricant over inside of gasket



Insert plain end of pipe until it contacts gasket



Force plain end to bottom of socket . . . the job's done!

6" Tyton Joint pipe for golf course sprinkler system in Illinois

## HOW TO HANDLE WET JOBS

*#43 of a Series*

*Project:* Power Plant, Yankeetown, Ind.
*Contractor:* Traylor Brothers, Evansville, Ind.
*Owner:* Aluminum Company of America

**Deep wet foundation rushed to completion as...**

# "Aquahog" Wellpoints Yield 32 Million Gals per Day

With water from the adjacent Ohio pouring through coarse-layered soil, the sub-surface of Traylor Brothers' job-site was like a free-flowing channel from the river.

- **Speedy, dependable** predrainage demanded more than routine methods, and the wellpoint engineers turned to "Aquahog" wellpoints (a special Griffin type with double the usual capacity).
- **Photo shows** the job bone-dry as the multi-stage "Aquahog" wellpoint system pumps 32 million gallons per day to lower 27 ft of ground water in the 40-ft deep open-cut excavation. With speedy, efficient, properly engineered ground-water control, the contractor met his tight schedule successfully. When *your* wet work needs special handling, investigate Griffin's special-purpose equipment.

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# . . . . . Am-Soc Briefs

► ► Congratulations and thanks to the Oregon Section for its masterly job on the Portland Convention. . . . It was an outstanding meeting with every hour profitably and pleasantly accounted for. . . . The Board of Direction nominated Vice President Francis Friel, Philadelphia consultant, for next year's President; selected three new Honorary Members; endorsed the Prize Committee choices for the Society's coveted annual awards; and accepted a proposal of the Task Committee on Classification of Members for changes in membership designation. . . . There will be biographies and photos of Honorary Members and Prize Winners in the October issue. The proposal for reclassification, which will go to the Annual Convention in October for endorsement, will be presented in the September issue.

► ► Obtain engineering services by negotiation. . . . One of the Society's many professional efforts has been in the field of making federal, state and municipal officials aware of the soundness of negotiating for engineering services on the basis of qualification rather than of price. . . . A recent letter from the Department of the Air Force to Secretary Wisely, reproduced in facsimile in the "Society News" section, thanks the Society for clarifying the bidding situation for the benefit of a company under contract to the Air Force, and explains that an apparent request for bids for engineering services resulted from a misunderstanding. . . . The subject of competitive bidding is reviewed in the editorial lead in this issue.

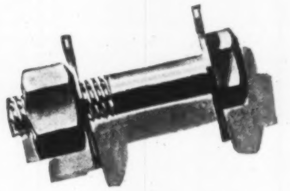
► ► Looking ahead to the Annual Convention. . . . The detailed technical and social program will be printed in the September issue. . . . In the meantime, this issue carries more about one of the most exciting Convention features — the joint four-day program of the International Association of Bridge and Structural Engineering and the ASCE Structural and Engineering Mechanics Divisions. To give an idea of the brilliant backgrounds of the thirteen foreign speakers taking part in their program, their biographies are summarized in the "Society News" section. A similar run-down on the U.S. speakers is scheduled for the September issue. Remember Chairman James Michalos needs to know how many more are planning to attend (page 110).

► ► Junior Members. . . . Your chance has come to speak up in Society affairs. Through the medium of a new column, "The Younger Viewpoint," started in this issue (page 76), you can make the opinions of the large and important group you represent really count. If you have a grievance, a problem, or a suggestion, be sure to get it off your chest. Correspondents for each of the four ASCE Zones are listed at the head of the new department, or you may communicate directly with Prof. Milton Alpern, of Cooper Union.

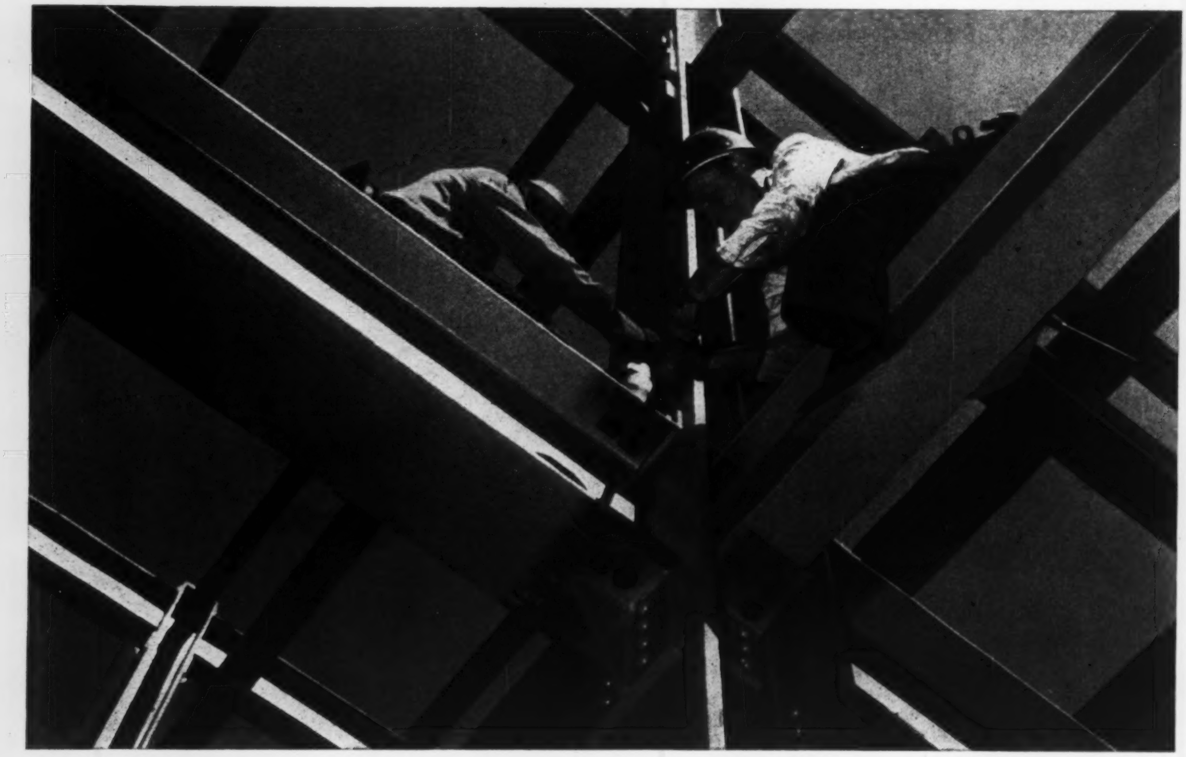
► ► Dean Weidner's address. . . . With Lebanon in everyone's thoughts, there will be renewed interest in the address, "Sputniks, Flopniks — and the Future of the United States," delivered at the Chicago Convention by C. Ken Weidner, M. ASCE, dean of the engineering faculty at the American University in Beirut. Members may obtain single copies without charge from the Executive Secretary.

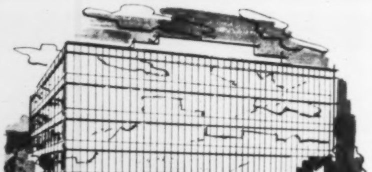
► ► For the first time ASCE will be represented on the program committee of the Joint Committee on Engineering Management Conferences. Roger Gilman and E. Warren Bowden are our appointees. The group will have its first meeting in September 1959.

# Steelwork for New Building in Oregon Erected Quickly . . . Quietly



## HIGH-STRENGTH BOLTS JOIN ITS STRUCTURAL MEMBERS





The new First National Bank Building, Portland, Oregon. Structure is being built in two stages, to avoid any interruption in banking service. Architects: Stanton, Boles, Maguire & Church. Structural Engineers: Cooper & Rosé. General Contractor: Hoffman Construction Company. Fabrication and erection of steelwork: Bethlehem Pacific Coast Steel Corporation.

The 815-ton steel framework for the new home office building of First National Bank, Portland, Oregon, was erected quickly and quietly with Bethlehem High-Strength Bolts. Some 6,000 of the husky steel bolts, in $\frac{3}{4}$-in. and 1-in. diameters, join the structural members of the five-story structure.

Bethlehem High-Strength Bolts speed erection time because they can be installed quickly. The nuts are run up by a pneumatic impact wrench. The bolts can also be tightened with hand spanners. Either method provides a tight, sound joint.

Besides saving erection time, high-strength bolting is relatively quiet, ideal for hospital and school zones. And with the bolts installed cold, there is no danger from fire, or injury from tossed rivets.

Bethlehem High-Strength Bolts come in carbon steel in commonly used sizes. They are quenched and tempered to meet the requirements of ASTM Specification A-325. Plan to use them on your next job.

BETHLEHEM STEEL COMPANY
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*On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation*

**BETHLEHEM STEEL**

BETHLEHEM STEEL

# do you know that

**Main-stem Missouri River reservoirs, when completed, will store 110,000,000 acre-ft?** Put another way, this is enough to cover North and South Dakota to a depth of 14 in. It is also the equivalent of the average annual flow of the Missouri at its juncture with the Mississippi. These data are from the Corps of Engineers, which is starting the closure of the Oahe Dam early in August (page 88).

• • •

**Last year fourteen states did not require a single course in mathematics or science, for graduation from high school?** For this disquieting bit we are indebted to a recent issue of Purdue University's "Sanitary Engineering News."

• • •

**A nuclear reactor is being used for experiments in artificial rainmaking?** University of Chicago scientists at the Argonne National Laboratory are using the Experimental Boiling Water Reactor for artificial rainmaking. The technique consists of seeding a steam cloud from the reactor's cooling tower with silver iodide particles. The rain formed is not radioactive, the scientists stress.

• • •

**The fastest-growing producer of aluminum today is the U.S.S.R. and its satellites?** According to the "Reynolds Review" for July-August, the Soviets now make 22 percent of the world's aluminum. The present total capacity of their dozen or more reduction plants is estimated at 286,000 tons, and informed observers predict that by 1961 production will have increased to 1,483,000 tons.

• • •

**The Richmond-Petersburg Turnpike has been opened to traffic?** Dedicated on June 30, the 34.7-mile four-lane superhighway will parallel Route 1-101 between the two key Virginia cities. In addition to adding another link in the improved north-south coastal route, the $75,150,000 project will expedite congested local traffic by serving as an expressway through both cities. Tolls will range from 70 cents for passenger cars, to $1.40 for tractor-trailer truck combinations with four or more axles. Parsons, Brinckerhoff, Hall & Macdonald were the engineers.

• • •

**There are 15,000,000 more jobs in the U. S. than there were in 1939?** What's more, nearly half our jobs didn't even exist in their present forms a quarter of a century ago. The situation is attributed in part to new industries, new processes, expanded programs in public health, education, marketing, and construction. These facts are brought out in a pamphlet, entitled "Your Great Future in a Growing America," issued by the Advertising Council (25 West 45th St., New York 36) as part of a public information program.

**The dollar volume of contracts awarded for construction on the interstate highway system during June was nearly double that of May?** According to the Bureau of Public Roads contracts awarded during June totaled $195 million for 469 miles of construction; for May $105 million for 215 miles. On June 30 a total of 3,167 miles of the interstate system were under construction at an estimated cost of $1,740 million. In addition construction on 23,300 miles of primary, secondary, and urban roads were underway at an estimated cost of $2,200 million.

• • •

**Putting "moons" in orbit is only one of the many advances made in the first year of the I.G.Y.?** Literally tons of data on the Antarctic, oceans, climate, atmosphere, and the earth itself have been accumulated by 66 countries at the end of the first year of the 18-month International Geophysical year. One of the many important findings is that millions of square miles of the Southeast Pacific ocean floor are strewn with needles of iron, manganese, nickel and cobalt, worth about $500,000 a square mile. It may be possible to recover this wealth.

• • •

**Two more links in Chicago's Expressway system will be opened in August?** The 76-mile Northwest Tollway—connecting South Beloit, Rockford, Belvidere, Elgin, and Chicago's O'Hare Airport—will go into service on August 20, less than 23 months after the start of construction. On August 27 Milwaukee and Chicago will move closer together figuratively with the opening of the northern section of the Tri-State Tollway. Completion of the Chicago Expressway, which is set for 1960, will provide direct access to the Loop Area from all directions.

• • •

**The U. S. can look forward to an ample supply of timber?** This is the contention of the U. S. forest industry, disputing a "Do You Know That" item (April issue), which quoted a U. S. Forest Service prediction of serious shortage by the year 2000. Forest Service officials are quoted as saying in a subsequent release that their report was "intended to give a picture of what *could* happen in the future—not necessarily what *will* happen."

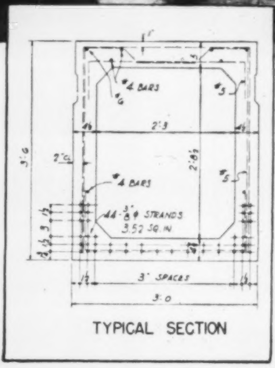
• • •

**Lack of scholarships does not keep good students out of college?** This is a conclusion of the Engineering and Scientific Manpower Commission, reporting a survey made last year by the National Merit Scholarship Program. Of the top 7,500 students, drawn from each state in proportion to population, about 97 percent are found to be in college. Of the next 7,500, about 95 percent are in college.

# 82-Foot Prestressed 'Incor' Box Beams
## *SPAN TROUBLED WATERS*

HOLLOW BOX BEAMS

Rectangular void, for economy in weight and material, runs length of beam. Total prestressing force—392 tons per beam. (below) Bridge length is 244 feet. Spans consist of 12 units, 36 inches wide. Deck width, 36 feet.



TYPICAL SECTION

● Among the flood control projects in the State of Pennsylvania is the Stillwater Reservoir that impounds waters of the Lackawanna River. Relocation of the highway in that area was part of the project, which included bridging the east branch of the river.

Need for economy and speed of erection in construction of the bridge determined the use of 36 long-span, prestressed, hollow box beams, each measuring nearly 82 feet in length, weighing 31 tons. Fabricated by Atlantic Prestressed Concrete Company in Trenton, New Jersey, the beams were transported over mountainous terrain to job site—a distance of 170 miles.

Economies were effected in the casting operation through use of 'Incor'*, America's FIRST high early strength portland cement, making possible early stripping of forms and fabrication at production-line speed.

Fabricator and engineers alike merit high praise in solving the knotty problems of transporting and erecting these giant beams—an outstanding performance in efficiency and skill.

*Reg. U.S. Pat. Off.

**STILLWATER RESERVOIR PROJECT**
Corps of Engineers, U. S. Army, Baltimore, Maryland

General Contractor
**LATROBE ROAD CONSTRUCTION, INC.**
Latrobe, Pennsylvania

Consulting Engineers
**GANNETT, FLEMING, CORDDRY & CARPENTER, INC.**
Harrisburg, Pennsylvania

Supplier of Prestressed Members
**ATLANTIC PRESTRESSED CONCRETE COMPANY**
Trenton, New Jersey

'Incor' Concrete supplied by
**WARNER COMPANY**
Morrisville, Pennsylvania

LONE STAR PORTLAND CEMENT
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LONE STAR Air-Entraining PORTLAND CEMENT
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THE ENTIRE CONSTRUCTION FIELD

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LONE STAR CEMENT, WITH ITS SUBSIDIARIES, IS ONE OF THE WORLD'S LARGEST CEMENT PRODUCERS: 21 MODERN MILLS, 48,900,000 BARRELS ANNUAL CAPACITY

CIVIL
ENGINEERING

# Obtain engineering services by negotiation

All members of ASCE know that it is unethical to invite bids for engineering services or to state a price for such services when invited, if it is expected that the selection will be on the basis of price. Article 4 of the Code of Ethics, indeed all the provisions of the Code, were adopted by our Society because we believed them to be in the interest of the public. In the case of public works, the public we serve is our client.

Although ASCE members who ignore the Code are subject to prompt disciplinary action, refusal to bid should be based on a desire to safeguard the interest of the client rather than to avoid the results of disciplinary action.

This provision of the Code is substantially the same as the ethical standards established by other engineering societies, by the American Bar Association, and by organizations of doctors and accountants. Federal agencies such as the Atomic Energy Commission, the Bureau of Yards and Docks of the Navy, the Corps of Engineers of the Army, the Department of the Air Force, the Department of the Interior, and the Public Buildings Administration have adopted, as sound procedure, negotiation for engineering services on the basis of qualifications rather than of price.

Some public officials have stated their belief that the laws and ordinances to which they are subject require competitive bidding on all contracts for public works, including professional engineering. However, numerous nation-wide decisions of the Courts have excluded the requirement that professional services be obtained by competitive bidding. In one such decision the Court held it was never contemplated that the making of contracts for the employment of attorneys, physicians, engineers and others where professional skills are involved should be let to the lowest responsible bidder. In another, the Court said a requirement that the selection of such professional men be based on the lowest bid "probably would be the best way that could be conceived for obtaining the services of the least competent man, and would be disastrous to the material interests of the county."

Whenever the attention of Society Headquarters is called to such a case, letters are sent to the officials concerned, explaining why it is undesirable and unethical to obtain professional services on a competitive-bid basis. In almost every case, the explanation has resulted in a changeover to an acceptable method of obtaining engineering services—that is, by negotiation with qualified and capable firms.

To make this educational effort of maximum benefit, members of ASCE are asked to submit to the Secretary specific information on any cases that may come to their attention in which bids for professional services are being invited.

Plans and specifications for construction and the materials that go into construction are precise and specific. Award of contracts for planned and detailed projects on a bid basis is accepted practice. Professional supervision guarantees compliance with the standards of adequacy, quality, quantity, size, and content agreed upon in the contract.

On the other hand, engineering requires creative intellectual ability, and it depends upon skills that cannot be standardized—judgment, experience, intelligence and integrity. No two engineers have the ability to render service with the same degree of competence, nor can the degree of competence be specified in advance. A client seldom knows the full extent of the engineering service he needs. He must depend on his engineer to do whatever is needed to assure the best results for him. The very small initial saving in a civil engineering fee that is realized by awarding a service contract to the lowest bidder is almost sure to be lost many fold by additional costs for the construction, operation, and maintenance of the client's project.

Advertising for bids for professional services and award of contracts to the lowest bidder is not required by law. Such bidding does not result in economical work. It is not in the public interest. For engineers to participate in such practices is a violation of the Code of Ethics.

**BEN MOREELL, Hon. M. ASCE**

**Admiral, CEC, U.S. Navy (Retired);**
**Chairman of the Board,**
**Jones & Laughlin Steel Corporation,**
**Pittsburgh, Pa.**

**Experimental pavement was constructed adjacent to Jones & Laughlin's Research Laboratory in Pittsburgh, Pa. Strip 12 ft wide has total length of 530 ft.**

# PRESTRESSING PROMISES nearly

A preview of the future American highway has been provided by the experimental prestressed concrete pavement constructed and tested by Jones & Laughlin Steel Corporation in Pittsburgh, Pa. This system of constructing highways promises to provide more nearly joint-free construction with all its attendant advantages.

The experimental pavement shows superior load-carrying capacity and the ability to conform to minor subgrade irregularities without cracking. It is free from the multitude of bumps and thumps usually encountered in concrete surfaces. It provides a waterproof roof over the subgrade. It promises to provide long life with low maintenance. All these advantages are obtainable without the penalty of additonal cost as compared with a conventional type of concrete pavement.

The experiment served also to demonstrate that the construction is easily within the capabilities of the average highway contractor. Very little equipment differing from that now used by the highway industry is needed. Most important, the rate of construction is not adversely affected.

Research in the highway field and the planning of safety-engineered highways has been greatly stimulated by the new program of highway construction. To match such improvements in modern highways, the best possible pavement is essential, provided that first cost as well as subsequent maintenance costs remain competitive.

When the Jones & Laughlin Steel Corporation undertook a study of possible uses of high-strength steels in pavements, their studies led to a consideration of prestressed concrete. No pavement type, old or new, gave as much promise for desirable improvements. The prospects were very attractive, provided the superior structural action, improved flexibility, freedom from cracks, and waterproofing over the subgrade could be obtained without excessive cost.

Studies of experiments abroad on the construction of prestressed concrete highways and airport runways provided much evidence that such pavement would have the desired properties. Cost analysis here and review of studies both abroad and in this country gave evidence that costs could be held to a competitive range.

Recognition of the need for proceeding promptly with research persuaded J. & L. to launch an experimental program. Otherwise, years of preliminary investigation might be expected before real progress could be made. Construction of the experimental strip was started late in 1956, and the paving was laid in the summer of 1957. To test the theoretical load carrying capacity of the pavement and to prove the practicability of construction, the experiment was made full scale. A strip 12 ft wide, with a total length of 530 ft, was constructed adjacent to Jones & Laughlin's Research Laboratory in Pittsburgh, Pa.

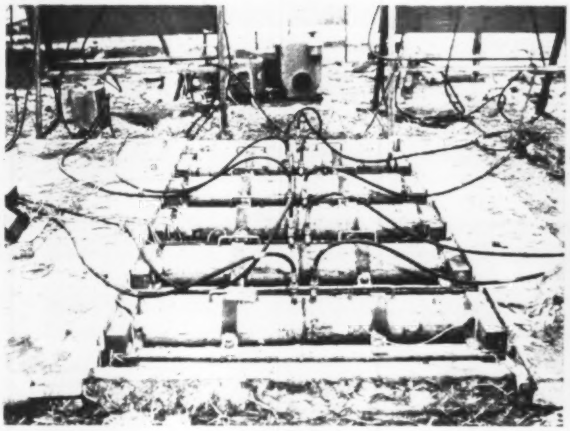
The pavement was designed to provide sufficient prestress to prevent cracking under extreme conditions of temperature warping and frictional restraint stresses while still leaving a residual to assist in carrying load stresses. Under the design wheel loading, the total bending stress would not exceed the residual prestress plus a fraction of the tensile value of the concrete.

Tension cracking would be expected under severe overloads. The analysis, later confirmed by tests, showed that the bending stresses were concentrated under, and rapidly decreased away from, the wheel load. As a result, redistribution would occur so that areas of low stress would pick up the load from the weakened section at a crack.

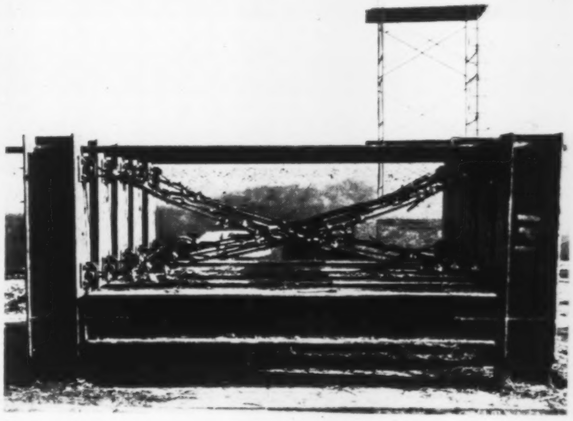
After considering all the possible variables, a slab thickness of 5 in. was adopted. Minimum cover over the prestressing steel was the most important factor determining this thickness. Were it not for this requirement, a thinner slab might have been used. The prestress level was set at about 450 psi.

The primary unit of the experimental construction was 400 ft long, 12 ft wide, and 5 in. thick. This main unit was flanked at one end by a 30-ft length and at the other by a 100-ft length. See Fig. 1. The short flanking units simulated additional long pavement units and permitted the use and testing of the expansion joint. The practical maximum length of a unit is limited by the friction losses occurring in the system and by the length changes resulting from temperature and other effects that must be provided for at expansion points. The tests showed that lengths of 600 ft or even 800 ft are feasible.

Because a major purpose of the experiment was to develop practical construction procedures, a description of the construction of the experimental pavement is of interest. The pavement site was undercut 3 ft and backfilled



Hydraulic jacks spread the sections of pavement to tension the cables for the 400-ft length of the primary unit.



Frames hold the slabs apart while jacks are removed and the concrete is placed and cured.

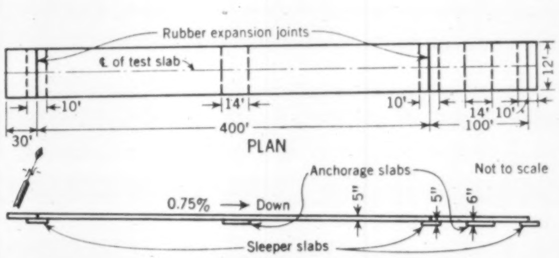
# joint-free concrete highways

to obtain a subgrade of known capacity with the minimum *k* permitted by highway specifications. This provided a less-than-ideal subgrade to add validity to the subsequent tests. A 6-in. granular subbase under the pavement was used, on top of which was placed a 1-in. layer of sand. The sand layer was to reduce friction between pavement and subgrade. A layer of slater's felt on top of the sand layer provided a smooth under side for the pavement.

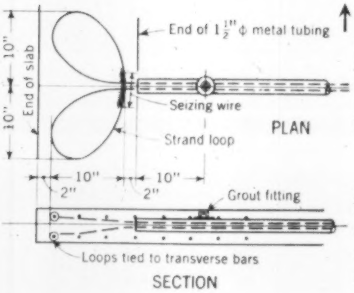
The pavement slab was provided with six steel tendons in its 12-ft width. Each tendon consisted of four stress-relieved prestressing strands of 7/16-in. diameter enclosed in a flexible steel duct of 1½-in. diameter. The strands, which were manufactured by Jones & Laughlin, had a minimum ultimate strength of 250,000 psi. This provided approximately 6.6 lb of prestressing steel per square yard of paving. When the strands were strained 24 in. in the 400-ft length, the unit stress varied from an average of 152,000 psi at the jacking point to 118,000 psi at the ends of the section, the average being 135,000 psi.

Post-tensioning of the pavement was done by a gap jacking technique. See Fig. 1. The tendons were anchored by bond with the concrete at the ends, leaving a gap at the center. The requisite prestress was then obtained by jacking the two half slabs apart. In this technique the initial prestress is a maximum at the center and decreases to a calculated minimum at the ends. A photograph shows the frame used to hold the gap open while the jacks were removed and the concrete placed in the gap.

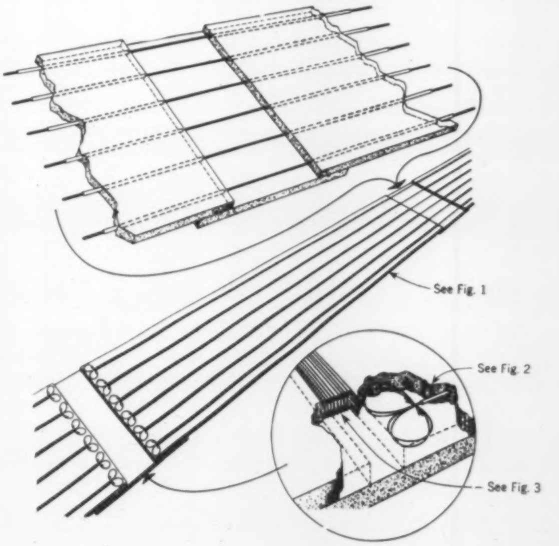
After the prestressing operation was completed and the concrete in the gap had been placed, the tendon ducts were grouted. No difficulty was experienced in grouting lengths as great as 200 ft.


Rubber expansion joints
℄ of test slab
12'
10'
14'
10'
14'
10'
400'
100'
30'
PLAN
Anchorage slabs
Not to scale
0.75% → Down
5"
5"
6"
Sleeper slabs
PROFILE

↑ FIG. 1. Pavement was post-tensioned by gap jacking technique. Two parts of slab were stressed by jacking apart the 14-ft gap between them.


End of 1½" φ metal tubing
10"
10"
End of slab
Seizing wire
Strand loop
PLAN
10"
10"
2"
2"
Grout fitting
Loops tied to transverse bars
SECTION

← FIG. 2. Prestressing strands are looped and anchored at ends of pavement lengths.


See Fig. 1
See Fig. 2
See Fig. 3

This technique has several important advantages. It permits the development of the prestress very near the end of the slab. No unstressed fill-in concrete patch is needed as would be the case if conventional end stressing techniques were used. The long extension of 24 in. needed to obtain the required prestress in the 400-ft length would make the jacking operation very difficult for conventional end stressing. Further, using conventional techniques the prestress would be at a maximum at the ends, decreasing to some unknown value dependent on friction at the center.

The end anchorage was accomplished by looping the strands at the ends as shown in Fig. 2. This had the advantage of fully developing the prestress within 24 in. of the end of the slab. In preliminary tests the anchorage was found to be very effective. When the concrete was eight days old, the strands broke at their ultimate strength without disrupting the anchorage.

The high end bearing at the jack rams was also investigated in preliminary tests. Steel bearing blocks 3 in. by 3 in. by 1 ft 3 in. long were used to distribute the bearing load. The unit bearing required was about 2,600 psi. Bearing at failure in the specimens was about 4,400 psi. The cylinder strength of the concrete in these specimens was about 3,300 to 3,500 psi.

One of the most significant developments in the project was the solution of the expansion-joint problem. Since there are no transverse joints or cracks from one end to the other of a prestressed concrete section, it acts as an unbroken monolith. All changes in length due to temperature, shrinkage, and creep are concentrated at the ends. In a 400-ft length the changes due to temperature could be as much as 3 in. (plus or minus 1½ in.). Of course, changes in length due to moisture variations tend to compensate for the changes due to temperature. Thus when the slab is hot it lengthens, but as the heat dries the slab it tends to shorten. Conversely, in winter when the slab tends to shorten as a result of lower temperatures, moisture tends to cause compensating lengthening. Table I gives length measurements taken during a six-month period. Obviously climatic conditions will affect the amount of end movement to be provided for.

Although the effects are compensating as shown in the table, the amount to be provided for any reasonable length of pavement, such as the 400-ft length used, is far greater than can be provided for with conventional doweled joints.

The solution developed worked well in the test program and promises to provide a final answer to this difficult problem. To prevent vertical displacement at the ends of the pavement unit and to carry load from the expansion joint, a subslab or sleeper slab was used. See Fig. 1. It was thought that the action under traffic loading would simulate that of the main prestressed pavement provided the sleeper slab were made relatively thin and of sufficient length. To accomplish this purpose, the sleeper slab is made 5 in. thick and 10 ft long.

The special subbase material was placed 6 in. deep under the sleeper slab as well as under the main slab. To control differential frost action at the edge of the sleeper slab, the subbase material was sloped up gradually to the 6-in. depth under the main slab. Thus any differential frost action that might occur could be accommodated by the very flexible prestressed pavement without cracking.

Mechanical joints are unsuitable because of initial cost, maintenance cost, and difficulty in keeping the joint free from dirt and water and proof against frost action.

A new concept of expansion joint construction was developed to perform the necessary function (Fig. 3). Steel plates sandwiched between rubber carry the load vertically into the supporting subslab. The rubber is so designed that during compression and expansion it will move into and out of the core spaces without seriously affecting the level of the top riding surface. Tests demonstrated that with a 3-in. compression the top surface remains level within 0.11 in. (Note in Table I that the measured change in length was less than 1 in. in 400 ft.) The rubber provides a complete seal against water and dirt and can be compounded to resist all the chemicals to which it may be subjected and to provide maximum wearing qualities.

Following the completion of the experimental strip, a series of static-load and moving-load tests were performed to evaluate its structural quality. Because of the limitations of the experiment, traffic-strip testing was not included.

The load-deflection relationship for edge loading was found to be linear up to the 66,000-lb loading, as shown in Fig. 4. The load versus concrete-stress relationship for interior loading on the left side of the figure shows that this relationship is linear up to the 40,000-lb wheel loading used in this test.

The curves for edge loading on the right side of Fig. 4 show some very interesting data. Note that under the rubber-tire loading shown for gage B 68 B, the edge gage, the curve is linear up to a loading of about 30,000 lb. The curve for gage B 68 A, for loading through the steel plate, indicates that this is a much more severe loading than the rubber-tire loading. This is shown by the flatter slope of the curve and the indication of crack formation at about 27,000 lb of load. This steel-plate loading is the only one that produced actual and obvious cracking of the 5-in. slab.

These are key curves for the development of design criteria for prestressed concrete pavements. Loads stressing the pavement from zero to

**Creep-speed load tests were made using dump truck with single rear-axle load of 23,000 lb. Static load is being applied in background.**

**TABLE I.**
**Length changes in prestressed slab with time**

| Date | Temperature, deg F | | | Dimension Change, in. $K = 0.0000055$ | |
|---|---|---|---|---|---|
| | Air | Slab | Differential | Calcul. | Meas. |
| Aug. 7, '57 | 89 | 95.3 | .... | .... | .... |
| Nov. 10, '57 | 26 | 31.2 | 64.1 | 1.69 | 0.72 |
| Jan. 3, '58 | 14 | 17.8 | 77.5 | 2.05 | 0.81 |

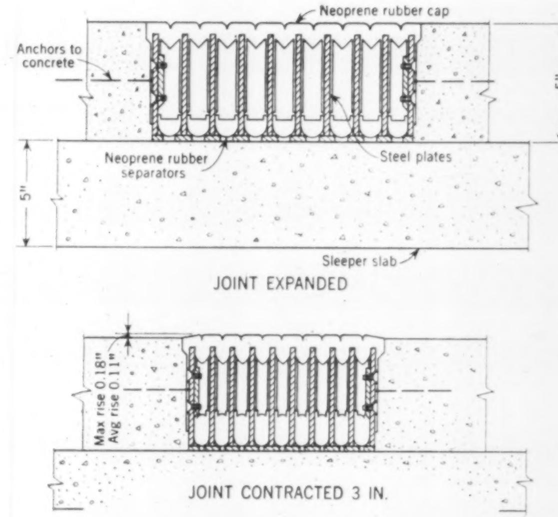


**FIG. 3. Special expansion joint consists of steel strips separated by neoprene rubber. Riding surface remains practically level even when joint is contracted 3 in.**

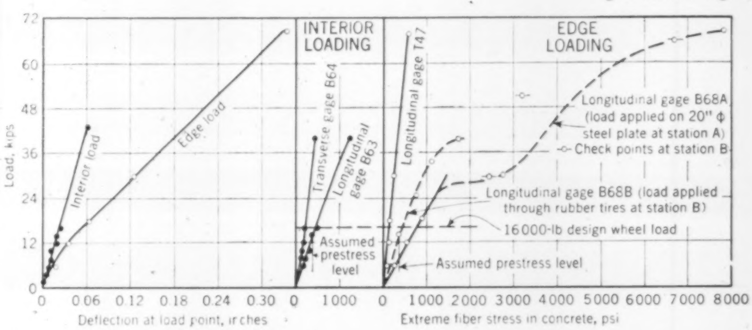


**FIG. 4. Completed pavement was tested with static "interior load" and "edge load." Deflection under cracking loads is plotted at left, stress under cracking loads at right.**

the prestress level obviously do not produce tension in the concrete. The curve indicates that for the steel-plate loading about 50 percent of the tensile strength of the concrete is utilized under the 16,000-lb design wheel load. Under the rubber-tire loading as shown on the curve for B 68 B, the tension in the concrete is very low at this 16,000-lb load level. Thus, even though, under extreme conditions, some of the prestress of 400 psi may be lost due to subgrade friction, the maximum concrete tensile stress will still be less than 50 percent of the modulus of rupture.

The curves confirm that the edge loading condition is critical. The stresses for interior loading for both longitudinal and transverse loading are at very conservative levels. These tests indicate that millions of load repetitions well in excess of the design wheel load can be withstood without fatigue failure. Further, the existence of initial shrinkage cracks in a pavement will not result in subsequent additional cracking.

Edge loadings of 40,000 lb were applied through the ties at two edge loading points without producing visible cracking. Since it was considered unsafe to exceed 40,000 lb through the tires, the steel-plate loading device was substituted. At 45,800 lb the steel-plate loading produced the beginning of edge cracking. At 66,000 lb, the crack had passed through the gage under the load as indicated by a runaway condition. Simultaneously, a half-moon or crescent-shaped crack appeared around the circular bearing plate.

Even this extreme loading (four times the design load) was not a true ultimate or destructive load because, on removal of the 66,000-lb load, the slab immediately recovered 90 percent of the total deflection. The edge crack disappeared and the surface cracks virtually disappeared. Within a few days after the test, the surface cracks disappeared completely. These tests showed that a longitudinally prestressed slab recovers properties even when subjected to severe overloads.

Creep-speed load tests were performed using a dump truck with a single rear axle load of 23,000 lb. Oscillograph records were taken of concrete strains and pavement deflections. These tests showed that stresses under moving loads were only about 75 percent of those found in the static-load tests at the same load level. This indicated the probability of a time relationship due, probably, to the slow reaction rate of the supporting subgrade. The deflection measurement under the moving load demonstrated that the expansion-joint sleeper slab behaved elastically.

The pavement was studied for warping under temperature gradient; the rubber joint was subjected to a series of tests; and many other tests were run on the experimental slab. The results of these tests are summarized in a report presented before the Highway Research Board in January 1958. A motion-picture record of the important operations was made into a one-reel visual report on the experiment.

The work here described is the "first phase" of the development. Although the test results were extremely good, it is recognized that test sections will have to be subjected to practical and heavy traffic conditions. Construction and testing of such sections will be the responsibility of the various state highway departments.

Because the experiment was organized in such a way as to test construction methods, it offers a guide to the engineering of subsequent test strips. The indicated findings of the experiment may be summarized as follows:

1. The gap jacking technique appears to be the most practical and advantageous method. Simpler devices than those used on the experiment are under development.

2. The lower-than-expected friction factors indicated by the experiment appear to favor the use of 600-ft or even 800-ft pavement lengths. The 3-in. movement that can be accommodated in the expansion joint would be sufficient for these lengths.

3. The steel tendons can readily be used with greater efficiency than in this experiment. About 5.25 lb of steel per sq yd of pavement would probably be sufficient. This may be in the form of either wire or strand. The tendons would be prefabricated complete with conduit and grout fittings.

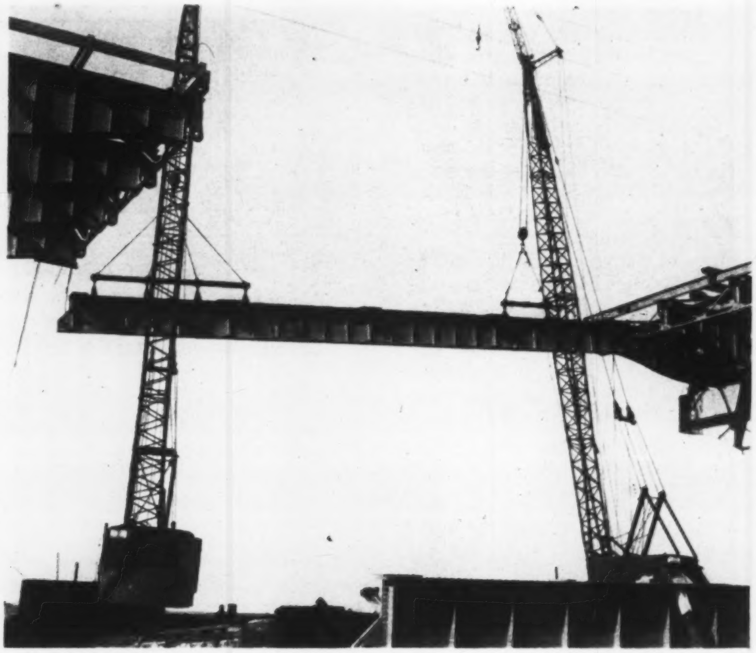
4. The basic prestressed unit would be two lanes wide, 5 in. thick, and 600 ft to 800 ft long. Prestressing would be in the longitudinal direction only.

5. The rubber expansion joint and the sleeper-slab system would be used in construction.

The experimental slab was designed by Richardson, Gordon and Associates. The constructor was the Allegheny Contracting Industries of Pittsburgh. Instrumentation was designed and fabricated by the Fritz Engineering Laboratory at Lehigh University. Advice and guidance was provided by the Physical Research Division of the Bureau of Public Roads.

**Two cranes on barges erect suspended girder in channel span.**

**Far Right: New bridge was built only 120 ft from old causeway (main view) and the latter was used in building the new structure. Inset shows old trestle and drawspan over former channel of Intracoastal Waterway.**



# NEW MANAHAWKIN BAY BRIDGES built for

When completed, the Manahawkin Bay Bridge will be the major structure in a series of four bridges across Manahawkin Bay, about 25 miles north of Atlantic City, N. J. This bay crossing will connect Manahawkin on the mainland of New Jersey with Ship Bottom, on a narrow offshore Island 19 miles long. See Fig. 1. The main bridge has an overall length of 2,400 ft and consists of thirteen spans 150 ft in length, two spans 125 ft in length, and two spans 100 ft in length.

The new crossing will replace the existing series of low-level timber trestles, a drawspan, and connecting causeways, which provide the only means of vehicular access to the offshore island and its summer population of about 200,000. The new crossing, which is being built parallel to and 120 ft distant from the old one, will be of vital importance should it become necessary to evacuate the island population in the event of a hurricane or other disaster.

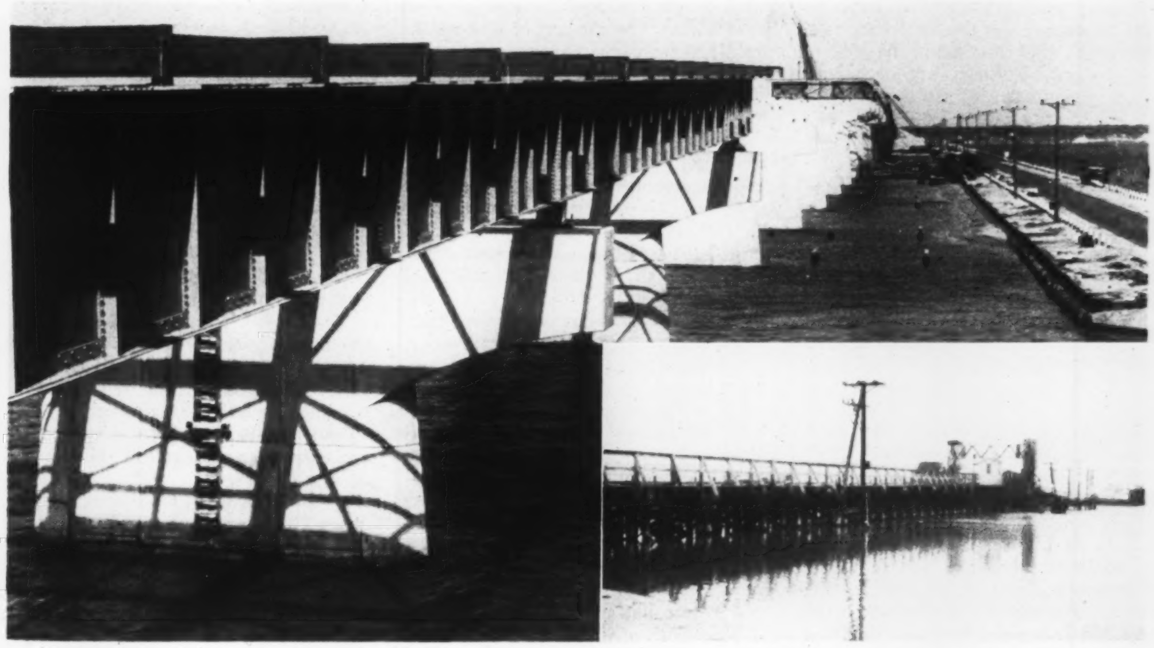
Our primary consideration in the design of the new bridge was to avoid a drawspan, as the existing one has been a source of serious interruption to highway traffic since it must be frequently opened to pass vessels through the Intracoastal Waterway. Therefore it was necessary to span the navigation channel with a high-level fixed span, and the next consideration was what vertical clearance would be required for this span.

In the State of New Jersey, it is necessary to obtain the approval of the State Department of Conservation and Economic Development, as well as the District Engineer of the U. S. Corps of Engineers for the construction of bridges over navigable waterways. Since the channel to be crossed is part of the New Jersey Intracoastal Waterway, it was necessary to provide for the vessels that customarily use this waterway. Our original application, for a vertical channel clearance of 50 ft at Mean High Water, encountered considerable opposition, and we revised it by increasing the vertical clearance to 60 ft.

It should be noted that, as shown on the map in Fig. 1, it was necessary to move the channel in the Intracoastal Waterway from the east side to the west side of the Bonnet Islands. It was not possible to build a high-level bridge over the existing east channel because the structure would extend too far back over the approaches, with damage to properties along the highway. Fortunately, through the cooperation of the state Department of Conservation and Economic Department, the channel relocation was arranged.

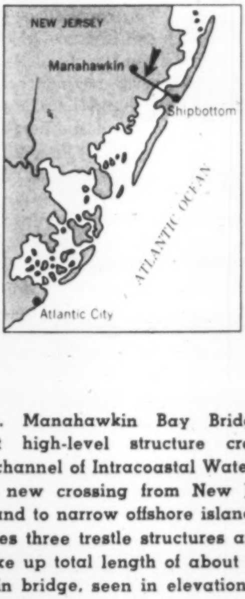
The cost of the high-level structure was compared with that of a low-level bridge with a drawspan. The estimated cost of the latter, with a drawspan providing an 80-ft width of channel and a 30-ft under clearance in the closed position, was $4,715,000. It was determined from our records that the cost of operating the nearby Seaside Heights-Island Heights bridge drawspan amounted to $30,000 a year. Capitalizing this amount at 4 percent would amount to $750,000, which would bring the total estimated cost of the low-level bridge to $5,465,000.

A fixed bridge, providing a 60-ft ver-



# long life across salt water

**LAWRENCE C. PETERSEN, M. ASCE**
**Director and Chief Bridge Engineer,**
**New Jersey State Highway Department,**
**Trenton, N.J.**


NEW JERSEY
Manahawkin
Shipbottom
ATLANTIC OCEAN
Atlantic City

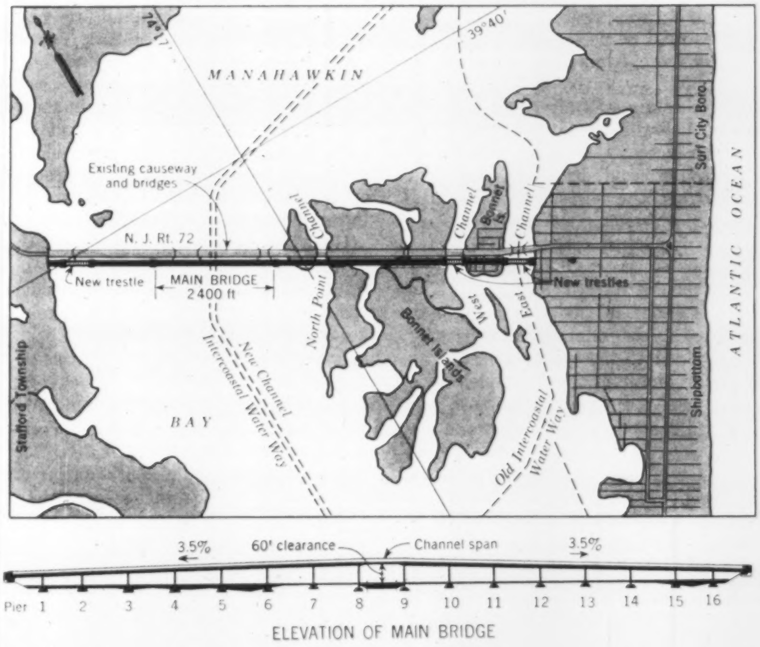

74°17'
39°40'
MANAHAWKIN
BAY
Existing causeway and bridges
N. J. Rt. 72
New trestle
MAIN BRIDGE 2400 ft
New trestles
North Point
Channel
Bonnet Islands
Bonnet Pt.
West Channel
East Channel
Old Intracoastal Water Way
New Channel Intracoastal Water Way
Stafford Township
Surf City Boro
Shipbottom
ATLANTIC OCEAN
3.5%
60' clearance
Channel span
3.5%
Pier 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
ELEVATION OF MAIN BRIDGE

FIG. 1. Manahawkin Bay Bridge is 2,400-ft high-level structure crossing main channel of Intracoastal Waterway. Entire new crossing from New Jersey mainland to narrow offshore island also includes three trestle structures and fill to make up total length of about 10,000 ft. Main bridge, seen in elevation, consists of 13 spans of 150 ft, two of 125 ft, and two of 100 ft.

tical clearance, was estimated to cost $4,624,000. To this would be added the cost of additional approach fills in the amount of $100,000, bringing the total cost to $4,724,000, or $741,000 less than that for the low-level bridge with a drawspan. A more important consideration, however, was the elimination of the serious delays to highway traffic resulting from the opening of the drawspan.

Before the bridge openings for this crossing were determined, a thorough investigation was made of the hydraulic requirements of the channels. At the time the existing timber trestles were constructed, over half of the waterway width was filled in, which reduced the waterway area below Mean Low Water to about 9,900 sq ft. This resulted in increased velocities, and scour to a depth of 20 ft in places, which practically restored the waterway to its original size of about 22,800 sq ft. The new crossing will provide a waterway of about 17,000 sq ft, making the average velocity through the openings 2.81 ft per sec. It is expected that scouring of the bottom will increase the waterway area and reduce this velocity considerably.

Because of the probability of scour, it was decided to encase the footings in steel sheetpile cofferdams, which would be left in place to protect the untreated timber piles from exposure to marine borers. The general arrangement is shown in Fig. 2.

The timber piles were driven, to an average depth of 55 ft below Mean Low Water, requiring a final penetration of about 10 ft in a hard sand stratum. It was expected that water jetting would be necessary in combination with the hammer to obtain this penetration, as proved to be the case.

The sheeting was driven to a depth of 35 ft below Mean Low Water, which was considered well below any possible depth of scour. Provision was made for driving the sheeting in two approximately equal lengths, with the unwelded horizontal joints in adjacent sheetpiles staggered a distance of 4 ft within the depth of the seal course. The lower sections of the sheetpiles were anchored to the concrete seal course by bars welded to the sheetpiles. See Fig. 2. After the pier was completed to above high-water level and there was no further need for the cofferdam, the upper lengths of piling were pulled for reuse on the next pier. With this method it was unnecessary to cut off the sheetpiles under water, and the amount of sheeting required was greatly reduced.

With the exception of the channel span, we were free to use any span length desired for the Manahawkin Bay Bridge. The element of economics was the deciding factor, and cost estimates indicated that a span length of 150 ft was the most economical. This was chosen. See Fig. 1.

Since this is a federal-aid project, it was necessary to submit the design to the Bureau of Public Roads, together with estimates of cost for substructure and superstructure. In reviewing the project, the Bureau questioned the economics of the design because the cost of the superstructure and substructure were not approximately equal. I have seen this criterion stated in early textbooks, and it may have applied to open-deck railroad bridges, but from our investigations it is not applicable to bridges with concrete deck slabs, sidewalks, and railings.

To convince the Bureau of the economy of the 150-ft spans, we prepared detailed estimates of the cost of 120-ft, 150-ft, and 180-ft spans, and demonstrated that the 150-ft span was the most economical, although the differences were not great.

The width of roadway on the bridge was established at 60 ft, with a 3-ft emergency walk on each side. It is planned to construct a center mall, 4 ft in width, in the roadway, which leaves a 28-ft roadway on each side for two lanes of traffic in each direction. If necessary in the future, the mall can be removed and provision made for five traffic lanes, with traffic direction reversible in the middle lane.

To avoid heavy flange sections, four longitudinal girders 108 in. deep were used, spaced about 18 ft apart. This resulted in 21-in. floor beams which rest on the girder flanges and are continuous over the four girders, with about a 6-ft overhang at each end. The floor beams are spaced at 12 ft 6 in., and the $9\frac{1}{2}$-in. concrete deck slabs span from beam to beam and rest on the top flanges. Every alternate floor beam is braced to the girders by brackets designed to resist overturning forces.

Girder webs have a constant depth of 108 in. except in the channel span, where the web depth on the suspended span was reduced to 66 in., thereby accomplishing a reduction of 3 ft 6 in. in grade elevations. Since this reduction extended the entire length of the bridge, including the roadway embankment on the approaches, it resulted in a very substantial reduction in cost. The girders are designed as continuous over two spans, with cantilever extensions of about 26 ft at each end. Suspended spans, about 98 ft in length, are attached to the ends of the cantilever extensions. Expansion is provided for in every third span by means of rocking links with pins of 8-in. diameter.

The girder layout results in bending moments that allow the use of 8 x 8 x $\frac{5}{8}$-in. flange angles throughout, except over the center pier support of the two-span unit, where 8 x 8 x $1\frac{1}{8}$-in. angles are required. At this support three cover plates, $\frac{5}{8}$ x 24-in., are needed on each flange. At the suspended span over the channel, special construction, using 8 x 8 x $1\frac{1}{8}$-in. angles and four cover plates $\frac{1}{2}$ x 24 in. on each flange, is required because of the reduced girder depth.

The girders rest on fixed shoes on the middle pier of the two-span unit and on expansion rockers at each side pier. This arrangement reduced the maximum length for expansion to 150 ft and permitted the use of expansion rockers rather than rollers. The maximum girder reaction at the fixed shoes was 805 kips and at the expansion shoes 734 kips. Transverse construction joints in the concrete floor slab were provided over the center support of the two-span unit at each end of the suspended spans. Double floor beams were employed at these points.

Lateral wind bracing is provided in the plane of the top flanges between the outer girders and the adjacent inner girders. Sway frames, spaced at 25 ft, join all four girders. Shear locks are provided to transmit the horizontal wind force from the suspended spans into the supporting cantilevers.

The lighting system on the bridge is different from any we have used on other bridges. It consists of fluorescent units mounted in a continuous line in the top rail of the bridge railing. The top rail also provides a raceway for the lighting cables. The continuous line of light along each rail is expected to provide a lighting intensity of not less than 2.5 ft-candles between curbs.

Two contracts have been awarded for the construction of the bridge, one for the substructure, at $1,350,000, and one for the superstructure at $3,158,000. This makes the cost of the superstructure nearly $2\frac{1}{2}$ times that of the substructure. The total bid cost of $4,508,000 compares favorably with our original estimate of $4,624,000. An additional contract for approach embankments and bulkheads has also been awarded, at $1,268,000. The cost per square foot of bridge deck, measured between railings and from end to end of the deck slab, is $28.50, which is considered reasonable for a bridge of this type which is in an exposed location.

The three additional crossings, which are now under construction, will have a total length of 1,163 ft and will consist of trestle-type bridges with a series of 40-ft spans. The most easterly trestle bridge crosses the old channel

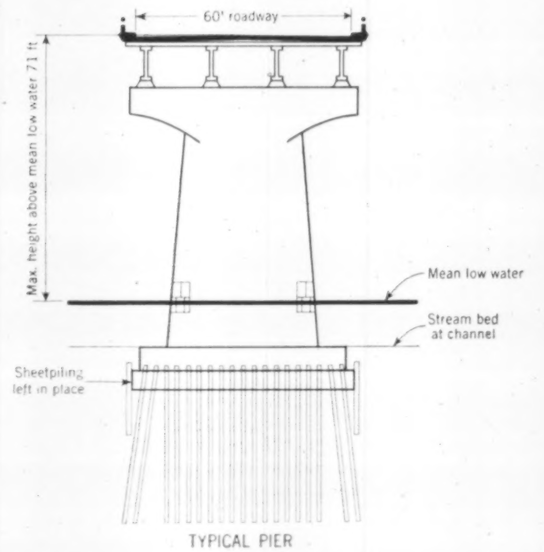
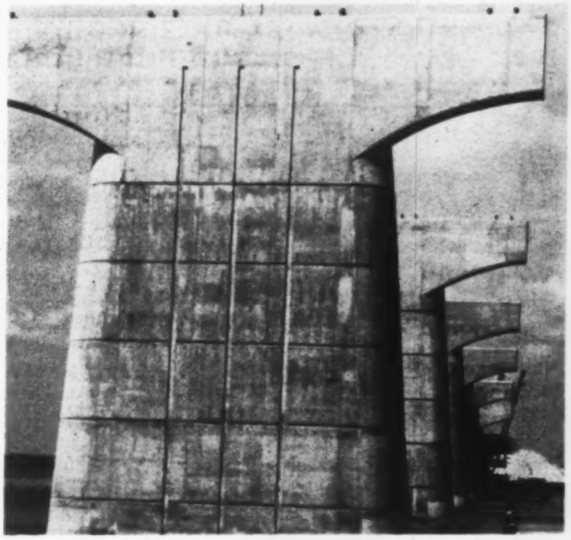

60' roadway
Max. height above mean low water 71 ft
Mean low water
Stream bed at channel
Sheetpiling left in place
TYPICAL PIER

**FIG. 2. Typical pier rests on untreated timber piles. To avoid scour, footings were encased in steel sheetpile cofferdams.**



**Lower sections of sheetpiles were left in place, as shown, to prevent entrance of marine borers.**

leading to the existing drawbridge, so it will not be possible to complete the construction of this fixed bridge until the main bridge is completed and waterway traffic diverted to the new channel.

Complete plans were prepared for three alternative types of construction for these bridges: one using structural steel stringers with a concrete deck slab, one using prestressed concrete I-section stringers with a concrete deck slab, and one using the hollow box type of prestressed concrete with an asphalt roadway surface. Competitive bids were obtained on these.

The low bid of $1,517,641.86, was for the prestressed concrete I-section stringers, and the contract was awarded on this basis. The second lowest bid of $1,569,953.63, was for the steel-stringer type. The unit price bid for the steel stringers was 15.7 cents per lb.

Substructures were designed as creosoted timber pile bents with concrete caps. This use of creosoted timber piles may be somewhat surprising to many engineers in this day and age, but it is justified by our experience with both concrete and timber piles. For example, a few years ago we had occasion to rebuild some timber-trestle bridges on Absecon Boulevard, leading into Atlantic City. When the creosoted piles of these bridges, built in 1920, were tested by boring, it was found that they had enough serviceable life after 34 years to justify using them to support the new concrete deck.

This record contrasts sharply with that of the Upper Manasquan River Bridge on Route 70, built in 1936. Here the concrete piles had deteriorated so badly within the tidal range after only 20 years that they had to be reinforced with concrete encasement and metal shells costing about $420 a pile. On the Ocean City-Somers Point bridges, built in 1932, an expenditure of several hundred thousand dollars was required to restore the precast concrete piles to a serviceable condition. I am afraid that, in the zeal for "progress," there is a tendency to discard time-tested construction in favor of new types promising advantages that do not materialize.

In designing the three trestle-type bridges, an attempt was made to maintain a minimum underclearance of 14 ft above Mean High Water. We have observed on other bridges in this area that there is a severe disintegration of the under side of the deck in those sections where the deck is less than 12 ft above Mean High Water but that the disintegration rapidly disappears as the deck reaches higher elevations. This zone of deterioration has been carefully avoided on these trestles.

We have also observed severe erosion and deterioration of the concrete piers of other bridges. This has been guarded against by placing a stone facing extending about 4 ft above Mean High Water on the piers of the new Manahawkin Bay Bridge. This problem was solved in an inexpensive way on the bascule pier of the old bridge in 1923. We simply drove a steel sheetpile cofferdam to the outline of the pier, excavated for the foundation, drove piles, filled the cofferdam with concrete, and left the sheetpiling in place. The pier has been in place for 33 years without any expenditure for maintenance.

The existing causeway and trestles, which are adjacent and parallel to the new bridge and trestles, were utilized in the construction of the new structures. During the construction of the piers, connecting trestle sections were constructed to each pier and the operations of cofferdam construction, pile driving and concreting of piers were carried on from these platforms. The steel members were delivered by truck on the trestles and were erected by cranes on barges.

The concrete deck slab on the main bridge was poured using transit-mix concrete. In the beginning, the contractor pumped the concrete in place but later he used buggies.

Brann & Stuart Co., of Trenton, N. J., were the contractors for the piers and abutments of the main bridge and also for the three trestle-type bridges. The Conduit & Foundation Corporation of Philadelphia were contractors for the superstructure of the main bridge.

The bridge was started during the term of former Bridge Engineer Morris Goodkind, M.ASCE, and since November 1955 has been under the jurisdiction of the writer. The design of the structure was by W. F. Hunter, M.ASCE, Assistant Director and Chief Bridge Engineer. The bridge will be owned by the New Jersey State Highway Department. Dwight R. G. Palmer is State Highway Commissioner and Otto H. Fritzsche is State Highway Engineer.

# Unity now through EJC

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*Unity through the structure of EJC, as editorialized by the author in* Civil Engineering, *August 1957, is now ASCE official policy. The original suggestion for adoption of this editorial as the ASCE policy came from Dean Harold E. Wessman, M. ASCE, of the University of Washington, Seattle, Wash. The present article is based on Past President Lockwood's address before a general session of the Society at the Portland Convention.*

**S**tated in the form of a proposition, the most unity can be had the quickest through the general structure of Engineers Joint Council. To be a mathematical proposition this statement would have to be capable of demonstration or proof. My conclusion fails to meet this requisite, as does any opinion on how best to achieve unity, for it simply is not subject to advance proof. Technically, therefore, this is a proposition in the logical sense alone—a thought capable of being believed, doubted or denied.

I am, therefore, merely going to recite the circumstances which have led to my conclusion on unity, enumerate my reasons for favoring the EJC approach, and finally, propose some basic changes which I consider essential for EJC to fulfill the unity aspirations of individual engineers.

### War and no peace

When my tenure as Vice President and later as President of ASCE moved me into the national engineering environment, I was quite unprepared for evidence of mutual bitterness among the national leadership of some of the organizations. And I was utterly dismayed to find a polite and undeclared cold war smoldering between some segments of the societies. A civil war over —of all things—unity. Not a civil war to preserve the Union, or unity, but one to preserve or enhance the prestige of individual engineering organizations. And this, incredibly, by outstanding and usually sincere leaders.

At the most critical times, the cause of unity in the profession seems to have been set back by a few stubborn men, men whose philosophy of compromise demands the opposition's complete capitulation—unconditional surrender or nothing. Strangely, these have been good men; they are merely miscast for this role. To them, this civil war over unity has been a holy war; they have been its Crusaders.

The engineers of the rank and file who chose these leaders want nothing for their profession quite so earnestly as simple unity—nothing complex, only a single, dignified, powerful but responsible voice of engineering, a voice reasonably representative of and responsive to the majority will in the profession.

After meeting with many engineering groups and talking to hundreds of individual engineers all over this country, my ideals about national unity of engineers became a casualty of harsh realism. The unity controversy, and it is a controversy, has resolved into a struggle, and it is a struggle, between the EJC and the NSPE ideologies. I propose to deal with it as such.

As a working member of NSPE and of EJC by indirection, I am an unabashed advocate of EJC as the unity vehicle for the profession. Not, though, without major expansion and redirection of EJC activities.

### The alternates to EJC

Two alternates to the EJC concept are currently being widely discussed. One, of course, is NSPE. The other is the three-headed plan for elimination of overlapping effort between EJC, NSPE and ECPD. It was authored by AIEE Past President Elgin B. Robertson. This plan was first sponsored in behalf of AIEE by its then President, Mervin S. Coover and it has thus come to be known as the "Coover Plan."

The idea here would be to eliminate general confusion and duplication of effort by an agreed assignment of activities among these three national engineering organizations. Basically, EJC would coordinate all high-level technical functions, ECPD educational functions, and NSPE professional activities.

Elimination of duplication is a worthy objective, and this plan would do that if it were invoked enthusiastically. But to pursue unity through this triple-headed device is, it seems to me, to acknowledge that this is the best we can do; that there can be no real unity in our time. I am not ready to throw in the towel for this generation.

Some object to the Coover Plan because it would build up NSPE at the expense of EJC, or that it would destroy EJC. This is not the basis of my objection. I am against it because at best it is a poor compromise.

Patently, NSPE, the other alternative, would be the answer if most of the engineers who could, would join and support it now, in our time. But what realistic hope is there that NSPE, any time soon, can legitimately claim to represent the engineering profession, either because of a truly representative membership or because the majority of the nation's engineers, whether members or not, are willing to be represented by NSPE?

NSPE is going to keep on growing, but so is EJC. The representation levels now stand at about 10 percent of the engineering profession for NSPE and 50 percent for EJC, with respective membership totaling about 50,000 and 250,000.

What will be the relationship "*x*" years hence? 100,000 members in NSPE vs. 50,000 in EJC? And might this not still be 10 percent and 50 percent of the country's engineers? If so, where are we going this way? Nowhere, it seems to me. There would still be no single voice for engineering.

One of these outfits should go out of business, you might suggest. Maybe so. But neither voluntarily is. Nor is either going to give up its identity.

### The solution—logical and psychological

A merger is called for. But to speculate about EJC joining NSPE doesn't even make good nonsense. NSPE could, though, join EJC and retain its identity. I think it should. I believe this would accelerate the growth of both organizations. More important, this would be a decisive triumph for unity of the profession.

I think also that ECPD should be merged with EJC. ECPD is best known for its highly regarded accreditation work in the field of engineering education, but many of its broader objectives are organically parallel to those of EJC. The good and necessary work of ECPD might better be carried out under the EJC banner. Should it be desirable to retain the identity of ECPD, the organization might function much as does Engineering Manpower Commission under EJC.

Let us now consider what sort of unity organization, what kind of coordinating agency, how effective a voice for the profession, we might have in EJC with NSPE as a constituent and with ECPD incorporated in EJC. In my judgment, right now we would have a shockingly inadequate agency for these purposes. Although structurally sound, EJC is beset by a number of serious weaknesses. Because it has not been properly appreciated and supported, it has never begun to reach its potential. As a matter of fact, it hasn't gotten off the ground. Because I have faith in the potential of EJC, I have critically considered the factors which I believe are standing in its way.

**EJC not sufficiently representative.** No engineering organization is satisfactorily representative of the profession. That, of course, is why we discuss unity. EJC is the most representative from the standpoint of numbers for which it is licensed to speak. But its critics contend that it can never be truly representative or satisfactorily responsive, because it is a federation rather than an individual membership society. I disagree with this dogmatic view. Hence the individual-membership clamor has never bothered me.

We get along in this country fairly well under a system wherein we elect people who appoint other people; these people together run our government for us. The majority will of the engineering profession can be translated into action in a similar way, through the existing EJC structure. Hence the essentiality of individual membership seems quite questionable.

EJC is not, though, adequately representative now. Not, however, because of any structural defect. Its Board of Directors is composed of representatives from the governing bodies of the constituent societies, in numbers proportional to the membership of their respective societies. These representatives and their alternates are chosen largely from the New York City area—for reasons which I shall discuss later. This leaves the rest of the country unrepresented by people close at hand. As a practical matter, this means that, except in theory, the rest of the country is largely unrepresented.

I have analyzed the composition of, and attendance at EJC Board meetings in 1955, 1956 and 1957. Some of the results are summarized in Table I.

It is interesting to examine the corresponding participation in meetings of the Executive Committee of the EJC Board. Eight persons participated one or more times in the five Executive Committee Meetings of 1955; 10 in 1956 and 16 in 1957. Only three of the 34 participants for the three years lived outside the 100-mile circle around the New York area.

NSPE Board meetings are large and quite representative. The average number of states represented at each of the three NSPE Board meetings for 1955, 1956 and 1957 were 37, 39 and 40 respectively. On this, EJC for the time being might as well say to NSPE, "touché!" For a national viewpoint, a national outlook, can only come from a truly national representation. But, as you consider this, be sure to remember that the small group of men who have comprised the EJC leadership are dedicated engineers, usually with an extraordinary interest in the advancement of the profession and exceptional willingness to make personal sacrifices to that end. Moreover, the desire or necessity for avoiding large outlays for travel expense and undue loss of the time of busy engineers is, of course, the principal reason for the consistent over-concentration of New York area men on the EJC Board. That this would assure good attendance at the meetings doubtless has also been a factor.

**EJC not known well enough.** EJC is becoming fairly well recognized in federal governmental circles but not, generally, at state levels. More serious, only a very small percentage of engineers really know anything about EJC. This is so even among those whom it specifically represents through their membership in its family of societies.

The EJC Board is doing everything it can, within the limits of present capabilities, to overcome its major handicap—comparative obscurity. For example, its activities are being better publicized. Its first regional meeting was held this year, in Chicago. There will be other regional meetings. But admittedly these are puny things compared to the need.

**EJC is woefully underfinanced.** Finally, I come to the ultimate road block in the way of EJC—or any other organization—becoming a satisfactory unity agency for engineering: money. It is the lack of money, of course, which is the root of this evil.

I have no idea how much money all of the engineering societies combined may be spending annually for the advancement of the profession as a whole. ASCE has always been a leader in this field. We are nevertheless committed to EJC as the unity organization—the ultimate coordinating agency.

EJC is directly obligated in this respect to some 250,000 engineers. It does whatever it can for all engineers—or say, another 250,000 engineers. We expect it to do this effectively—and here I suggest you hold on to your seats—for about $70,000 per year, only about $50,000 of which is provided by engineers through contributions by their respective societies.

Each of the 250,000 who is carrying this great burden for himself and one freeloader, is laying out 20 cents per year for this purpose. A family's annual budget would look silly if, buried among its hundreds of dollars for this and for that, there were a 20-cent item for insuring the future for itself and one other family.

That we should try seriously to do what all of us want done but provide

**TABLE 1. Residence of representatives and "working" alternates on EJC Board, 1955, 1956, 1957**

| | 1955 | 1956 | 1957 |
|---|---|---|---|
| Number of board meetings | 5 | 6 | 5 |
| Total number of representatives and alternates (including officers who participated in one or more meetings) | 31 | 38 | 40 |
| Number residing in New York City area | 18 | 24 | 26 |
| Number residing within 200 miles of New York City | 25 | 35 | 35 |
| Number residing within 1,000 miles of New York City | 31 | 38 | 38 |

only 2 cents per month for the purpose, is either pathologically absurd or absurdly pathological. Those with a punning instinct will pardon my asking my fellow engineers, Are we men or misers?

## Now what?

I have finally reached the "now-what" stage of this discussion. Here are some things that the engineers of this country might do to, and through, EJC to achieve unity:

1. Change the name of Engineers Joint Council to "The American Engineering Association," if this is at all feasible. Obvious gains from adoption of this logical name for the topmost organization in the profession should far outweigh the losses, especially since EJC has not yet attained popular recognition. This would entail difficulties. For example, possible conflict with the 5,000-member "American Association of Engineers," headquartered in Chicago.
2. Merge ECPD with EJC as quickly as possible.
3. Persuade NSPE to come into EJC, and to continue its work and rapid growth under the common banner of a coordinating agency which NSPE helps to direct.
4. Provide EJC with sufficient funds to accomplish its coordinating mission. As a starter, its supporting societies might arrange to increase their per-member subscriptions 50 percent each year for about the next four budget years.

These additional funds should be employed in overcoming the non-representative composition of the EJC Board from the geographical standpoint and the lack of public awareness of EJC. The remedy lies in appointment by constituent societies of representatives and alternates who are geographically dispersed. To make this feasible, EJC should pay their travel expenses to Board meetings.

With or without a change of name, it is going to be necessary to spend money to establish and maintain an appropriate unity organization for engineering. Some needs to be spent for such things as regional meetings and officer and staff travel, and more for ordinary public relations.

## Conclusion

It is not at all mere idealism to believe it possible for engineering to have a single coordinating agency, the name of which will become a recognized household expression like the American Medical Association and the American Bar Association. For engineering is second to no other profession in essentiality to mankind, and it is second only to teaching in size.

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**CHARLES E. CARVER, JR., A.M.ASCE**

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# How can engineering

"Maybe Mr. X knows his stuff, but he certainly can't put it across," remarks one engineering student to another. How prevalent are such remarks behind the backs of engineering instructors? Is poor teaching an incorrigible characteristic of Mr. X, or can something be done to change it?

In recent years considerable attention has been directed to the curriculum, and rightly so, in the face of an almost fantastically changing technology. But it seems to be assumed a priori that all engineering teachers know the mechanics of sound pedagogy and are equipped with the necessary understanding of the students to whom they give instruction.

The demand upon teachers in science and engineering to engage in basic research to an ever-increasing extent must not be allowed to overshadow their primary function of educating students. The discussion that follows applies primarily to the preparation of incoming engineering instructors who will be teaching at the undergraduate level. It is not intended to exclude incumbents, however, in either the undergraduate or graduate fields.

First it is necessary to inquire as to the sphere from which potential instructors will be drawn. The primary source, of course, is the student body itself. In every graduating class there will be a few students who will have the necessary capacities for becoming fine teachers. It is a duty of our engineering faculties to recognize students whose gifts lie in this direction and to encourage them to choose teaching careers. To do this of course the observer must be able to recognize those qualities which distinguish the first-rate teacher. It is impossible here to discuss all the multifarious factors that characterize a good instructor. Many such factors are inherent in the individual personality; no amount of formal educational training in the art of teaching can be expected to alter them, nor would it be desirable to do so. But the potential instructor can be equipped with certain basic tools designed to increase his effectiveness in dealing with students both inside and outside the classroom.

## The art of speaking

Of first importance is the art of speaking. Why is it that one lecturer is always able to command attention, to create an atmosphere of dedication to his subject, while another is treated to yawns and drooping eyelids, if not to the mortification of a student fully asleep? If we were to sit in on a lecture by a speaker of the former type, we would observe that he modulates his voice and avoids monotones, that he uses his hands extensively and moves about frequently, that he speaks directly to his audience and not to the clock on the wall, and that he punctuates his discussion with such artifices as a few anecdotes and humorous comments. In short, he utilizes such basic techniques as would form the core of any good course in public speaking. Would such a course, especially geared for engineering instructors, better their methods?

Another area worthy of consideration is that of audio-visual aids. Most colleges and universities maintain on their campuses some such facilities which are available for classroom use. Are these facilities adequately utilized and do instructors know how to employ them effectively?

It is said that one picture is worth a thousand words. How often do engineering teachers make use of the many engineering educational motion pictures to add interest to their subjects? Or substitute a slide projector or reflectoscope for a verbal discription to illustrate a point more concisely and with greater clarity? The instructor himself has an opportunity to display some ingenuity in constructing

# teaching be improved?

visual aids. These need not be elaborate but would serve to drive home difficult concepts that have proved particularly troublesome to students in the past.

Closely allied to the use of visual aids is the development of a good blackboard technique. No one will deny the usefulness of drawings to illustrate a concept, yet a poorly conceived, confused diagram can do more harm than good. There is usually no hope for bad handwriting, but legibility can be improved by printing. How often is colored chalk used to clarify a complicated diagram or sketch? Some readers may think these mechanical aspects of teaching too trivial for mention, yet they are the cornerstones on which the teaching structure rests. By such means information is imparted, and good techniques for imparting it can be acquired through proper training.

## Psychology is important

The importance of psychology as it relates to the educational process has not been adequately stressed. Just how does a student learn? How can the degree to which he has assimilated information be measured? At present the hour test and final examination suffice. To what stimuli does he respond? What environmental factors affect his behavior? In short, what are the outstanding psychological characteristics of the college student in engineering?

To the instructor who can answer these questions belongs the ability to transform just another face in the crowd into a distinct and vibrant human being with likes and dislikes, capabilities and inabilities, successes and failures. It is a tool no less important to the teacher than the scalpel is to the surgeon. Nor is the responsibility to our "patient" any less awesome than that of the surgeon to his patient reposing on the operating table. We are charged with the heavy responsibility of developing, guiding and equipping the mind and the character of the student not only so that he can take his place as a respected member of society but also so that he can properly exercise his profession. But a little psychological knowledge can be a dangerous thing—training is needed for understanding.

Finally, there is one more tool that might well be borrowed from any department of education and that is the art of counseling. A teacher's responsibility does not end with the ringing of a bell at the close of a lecture. All teachers appreciate this. But when the student's inevitable knock on the door does occur, will it herald a problem with which the teacher cannot cope and about which he cannot even begin to offer advice or reassurance? His patient is frequently just plain confused and lost, not an uncommon characteristic of freshmen. The inquiring student may well be lost as a prospective engineering graduate; he may fail or transfer to another field solely for want of intelligent counsel.

## Training in teaching techniques

Taking it for granted that at some point in his career, a prospective engineering instructor should be given formal instruction on how to teach, as here proposed, the problem then follows: When and how can this be accomplished?

The first step can be taken while the prospective instructor is still an undergraduate. The obligation of engineering educators to recognize and encourage those students who show promise of becoming good teachers has already been mentioned. Such recognition can be facilitated by allowing the student to take over a lecture or two, say, in his senior year. The results should be revealing both to the student and to the instructor, for it gives the former the necessary "feel" of teaching and provides the latter with a means for evaluating the student's potentialities as a teacher.

One way to provide formal training in the art of teaching would be to offer a concentrated course, probably running for two semesters, consisting of instruction in such areas as public speaking, visual aids, psychology and counseling, especially adapted for engineering and given concurrently with the chosen field of graduate study. (It is presupposed that the student will be encouraged to work for an advanced degree.) Few graduate programs at present could make room for such an addition without an extension in time. Yet such training for the teacher is not unlike an internship for the medical man. Teaching itself is a profession and as such requires training if it is to be practiced effectively. We should think seriously about finding the time for such training.

Perhaps the next best solution, should it be found completely impractical to incorporate such a program in the graduate curriculum, would be a manual for the engineering teacher, prepared along the lines that have been discussed. Such a manual would be read and digested at the convenience of the prospective instructor.

The questions raised here may seem picayune to many readers, but they deal with an area of engineering education no less vital than the curriculum. That the status of educators in all fields and at all levels is low on the totem pole of our national culture is one of the greater American tragedies. Nevertheless it does not cancel our responsibility to strive for the highest quality of teaching possible.

In conclusion, the writer would like to state that the opinions here expressed are his own, and do not necessarily reflect the thinking or policies of any institution. Comments or criticisms from the profession will be welcomed.

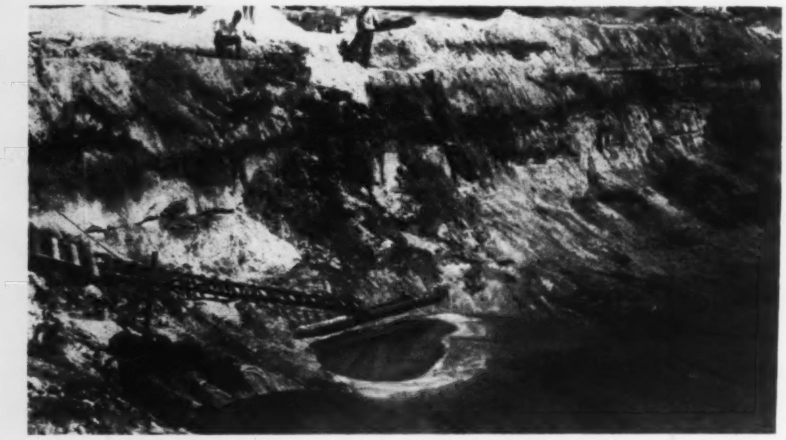

FIG. 1. Dual boil developed when the excavation was dewatered after flooding. Deltas were formed by fine-grained material carried by flow of 830 gpm.

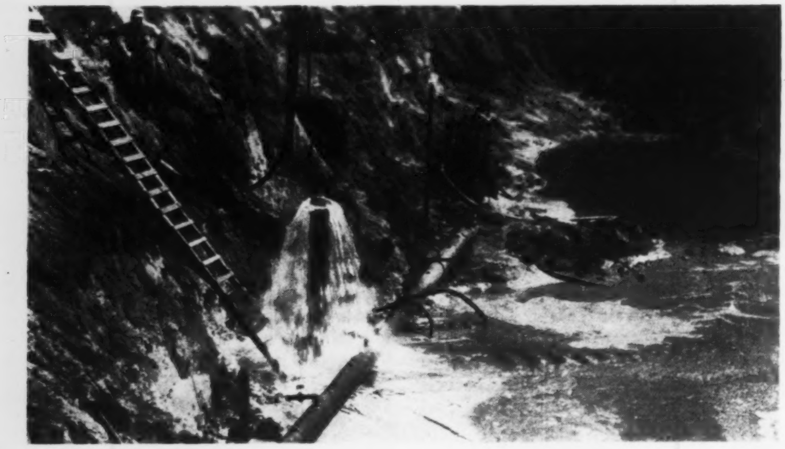

FIG. 2. A 10-in relief casing jetted into the aquifer produced 1,350-gpm flow at 9 ft below normal ground-water level in the excavation.

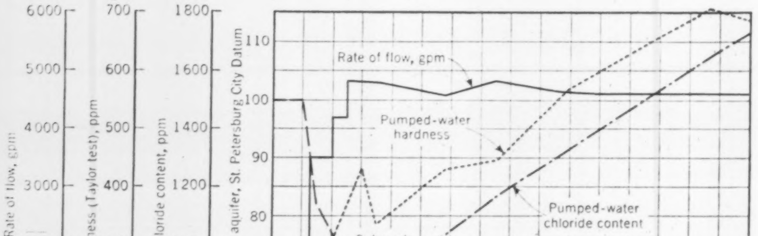

FIG. 3. Graph shows increase of hardness and chlorides with pumping. Also shown is decrease of piezometric head in aquifer with flow referred to St. Petersburg City Datum, where 97 is mean sea level.

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Excavation for the grit structure, the deepest unit of the Northeast Sewage Treatment Plant for St. Petersburg, Fla., was down 27 ft when a large boil broke loose, inundating the hole with 1,000 gpm of water.

The plant is literally surrounded by salt water. Riviera Bay is some 1,400 ft to the north; Bayou Grande, 3,300 ft to the east; and Placido Bayou, 1,800 ft to the south. All are tidal estuaries. Ground water is slightly below the surface.

The grit structure is 15 ft square and only 10 ft from a pumphouse whose subgrade is 5 ft higher. Both were under construction as one unit in an excavation measuring 80 by 100 ft. The excavation had been proceeding normally with a top wellpoint system 4 ft below ground level. This upper wellpoint system dewatered and stabilized the fine-grained soil for a depth of 16 ft, at which depth there was a lower-stage wellpoint installation.

The upper stage was connected to the lower stage by an auxiliary float chamber. Both stages were pumped by the lower-stage diesel-powered wellpoint pump. As is usual in fine grained soils in this area, the amount of water pumped was negligible, about 30 gpm for both upper and lower wellpoint stages—0.4 gpm per wellpoint on 5.25-ft centers.

Conditions were normal and excavation was proceeding about 3 ft above the final required depth. Suddenly, to the astonishment of job personnel, the boil broke out of the side of the excavation 5 ft above subgrade.

It is an impossibility to get 1,000 gpm from the fine Pleistocene sands or sands and marls of the Hawthorne formation that predominate in this area. Two borings bracketing the grit structure, taken before bidding on the job, had indicated only fine Pleistocene sands. While borings had extended only 12 ft below the structure depth, they touched the top layer of marl in the Hawthorne formation, which was assumed to be about 43 ft thick, indicating that the top of the Tampa formation, a water-bearing aquifer, would come about 65 ft below the grit-structure foundation.

As soon as the boil broke out, the lower wellpoint pumps were removed

# Pressure relief system tames Florida boil

and reinstalled on the top header line. Both wellpoint stages remained interconnected. By utilizing a Moretrench 12-in. diesel wellpoint pump as a temporary sump pump, and maintaining the discharge constant at 4,300 gpm, the water level in the flooded excavation was lowered. The boil flow was computed as 830 gpm at a 20-ft head. The boil had now divided into two flows some 15 ft apart (Fig. 1). With the hole flooded, the banks had sloughed, filling up the deep excavation.

By jetting a 2-in. pipe down at intervals around the circumference of the excavation, the soil conditions were investigated, and a hard layer was encountered 20 to 24 ft below the ground surface. Through the 2-in. pipe there was a flow of some 30 to 70 gpm at these elevations with a head of only 15 ft below normal ground-water level at El. 100.

Pieces of the hard rock layer were literally blown up through the probes. They were classified tentatively as gray marl at El. 60; white marl at El. 57; gray porous limestone at El. 51; brownish white porous limestone at El. 48; and dense white limestone at El. 46. Samples were forwarded to the U. S. Geological Survey for complete classification. As additional soil samples were obtained from various relief points and relief casings, the elevations and classifications were carefully recorded to obtain a clear picture of the various layers.

About 300 gpm boiled up out of one probe hole when the probe was withdrawn. Mechanical analysis of the clean sand coming from this probe hole and boil showed that it was from top layers. Being agitated, the clay had been removed. This was confirmed by microscopic examination of particle shape.

Different sources of the water were indicated by the samples, which were analyzed as follows:

| | TEMP. DEG. C | PH. | CHLORIDE | HARDNESS |
|---|---|---|---|---|
| Wellpoint system .. | 27.5 | 7.4 | 3,000+ | 2,000+ |
| Boil (830 gpm) . . . | 24.5 | 7.9 | 766 | 228 |
| Probe No. 3 (30 gpm) | 24.0 | 7.4 | 638 | 184 |

The hardness of the water from the boils came within the range of that from the Tampa limestone (the aquifer) which usually is between 150 to 225 ppm. However the chloride content was high. The normal chloride content of this aquifer is between 250 and 500 ppm. This high chloride content might be explained by the closeness of salt water bodies.

It became evident that there was either a pinnacle of Tampa limestone at about El. 48 or else the overlying Hawthorne formation contained a very pervious layer never before encountered. It may have been only a coincidence, but the boil developed in the immediate area where one of the two preliminary borings had been taken. If the confining marl layer had been punctured or disturbed by this boring, an area of least resistance would have been provided for the escape of pressure from the aquifer beneath.

## Control measures

Because of the large quantity of water expected, a 12-in. header pipe was laid directly on top of the lower header pipe—to be connected to two 12-in. diesel wellpoint pumps.

To properly install relief wellpoints, a Moretrench holepuncher was placed inside a 10-in. casing with the holepuncher protruding below the bottom. The whole assembly was jetted down with water at 140 psi until the casing had its tip at a predetermined elevation. The holepuncher continued to jet to a deeper elevation, cleaning out the casing and tapping the aquifer below. The holepuncher was withdrawn and a relief wellpoint of 4-in. diameter, with chelsea screen, was placed inside. A suitable filter material was poured between the casing and the relief wellpoint and the casing was withdrawn, leaving the relief wellpoint in the ground with the screen in the aquifer.

Since clear water flowed from the casing when the holepuncher was removed, it was assumed that if the casing could be firmly set in the marl or limestone layer, to seal off the sand above, then the casing could be used as a relief well directly.

Relief casing No. 3, of 10-in. diameter, with its tip at El. 57, but cleared out with the holepuncher to El. 46 (see Fig. 2), flowed at 1,450 gpm, which dropped in one hour to a steady flow of 1,350 gpm with a 9-ft head. When the top of the casing was cut off at El. 84 (at a head of 16 ft), the flow stayed steady at 1,750 gpm. The casing was then connected directly to a header (see Fig. 4), which in turn was connected with a 12-in. wellpoint pump. It produced 3,500 gpm at a vacuum of 23 in. or a total head of 42 ft. When these volumes are plotted against heads, there is almost a straight-line variation. After one hour of pumping, no stone fragments were pumped, and the water continued clear until the end of the job. The same was true of the other relief casings.

Another casing, of 8-in. diameter, was jetted down until its tip was at El. 57, and cleared out down to El. 45 with a holepuncher of 8-in. outside diameter. This casing produced a free flow of 470 gpm when a 2-in. relief point alongside measured a piezometric head of 2.3 ft. When pumped as a lone relief well, it produced 3,000 gpm with 20 in. of vacuum, but when pumped in conjunction with casing No. 3, it increased the total volume only 700 gpm—to 4,200 gpm.

A third relief casing, of 12-in. diameter, with its tip at El. 49, in conjunction with the other two, produced an increase of only 625 gpm for a total flow of 4,825 gpm.

Pumping these three relief wells caused the piezometric head, measured by wellpoint screens, to drop 7 ft below the deepest subgrade. A composite graph showing the decrease of piezometric head with increase in pumping volume, for the first 60 days of pumping, is given in Fig. 3. It can be noted from this graph that the addition of the third well only lowered the piezometric level 2 ft and added only 625 gpm to the total volume pumped. This was accompanied by a vacuum rise of 3 in. Subsequent experimentation was carried out and showed that any two of the relief wells would produce the same volume, 4,200 gpm, with the same vacuum.

This graph also shows the increase in chlorides and hardness during the pumping period. The sudden dip about the 14th day after the boil started is probably due to the completion of drainage of water from the Hawthorne

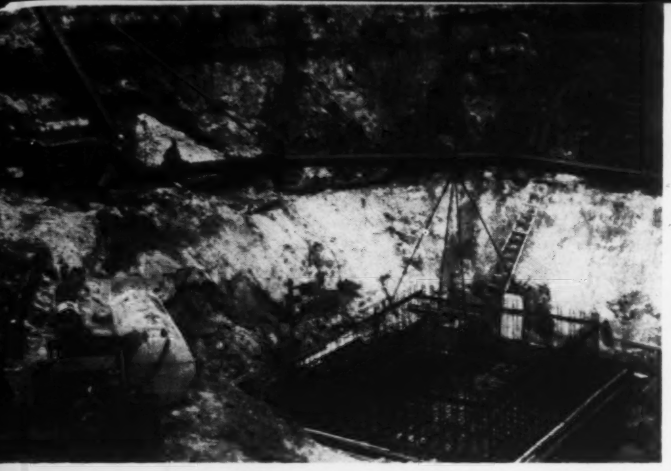


**FIG. 4. Only 17 days after boil broke out, the excavation is completed and ready for concrete. Note the two 12-in. diesel pumps and relief casings connected directly to the header.**

marl overlaying the Tampa formation. If this is the case, the chloride and hardness contents form a straight line, a direct proportional increase due to the infiltration of sea water from the tidal flats which surround the area on three sides. This is also borne out by the increase of 1.3 deg C in temperature—from 23.9 deg C to 25.2 deg C—in the first 38 days of pumping.

As soon as the piezometric head had been reduced below the elevation of the lower wellpoint setups, the wellpoint pumps were again operated on the second ring to restabilize the banks. Excavation could then be resumed. Forms were completed and the excavation was ready for concreting the floor slab 17 calendar days after the boil broke out. See Fig. 4.

Pumping was carried on continuously for more than two months after the boil started, to allow the structure to be completed and waterproofed. Then the 2-in. and 4-in. relief screens were removed. The 12-in. and 8-in. relief casings were capped and buried, but the 10-in. casing was extended to the surface for future use as a well. Four days after pumping ceased, the water level in this well fluctuated from El. 99 to 100 showing tidal effect and a slightly lower elevation than that of the original normal ground-water.

## Conclusions

Careful classification of soil samples obtained during the probing and installation of the relief wells made it possible to prepare a composite boring log, Fig. 5. This log, in comparison with the initial borings, showed plainly that:

1. The Hawthorne formation is much thinner than expected. There is a pinnacle or rise in the surface of the Tampa formation some 45 ft higher than previously known in this area. The layer from El. 43 to 52 was, in addition, extremely pervious and acted as a collecting layer for the Tampa limestone beneath.

2. The preliminary boring, while deep enough for normal dewatering estimates, was not deep enough in view of the existence of a potential pressure layer and aquifer.

3. Pressure in this type of pervious rock can be relieved by relief wells.

4. Intrusion of salt water may be expected with continuous pumping if bodies of sea water are near by. In the sixty some days of pumping on this job, an estimated 410 million gal were pumped and the chloride content rose from 600 to 1,800 ppm.

5. This confirms the principle of pressure relief, that a simple hydraulic system exists where: (*a*) an aquifer is under pressure; (*b*) relief pumps and wellpoints of sufficient capacity are used to reduce friction to a negligible factor; and (*c*) the discharge head remains constant.

Under these conditions: (*a*) the rate of flow increases directly as the vacuum (head) increases; and (*b*) the water level drops directly as the vacuum (head) increases.

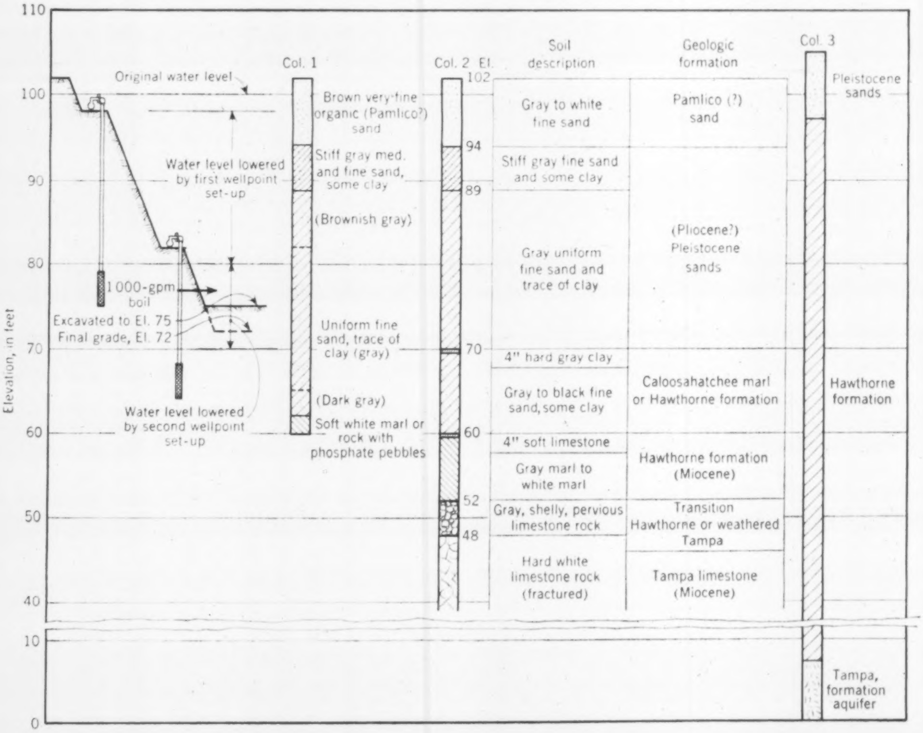
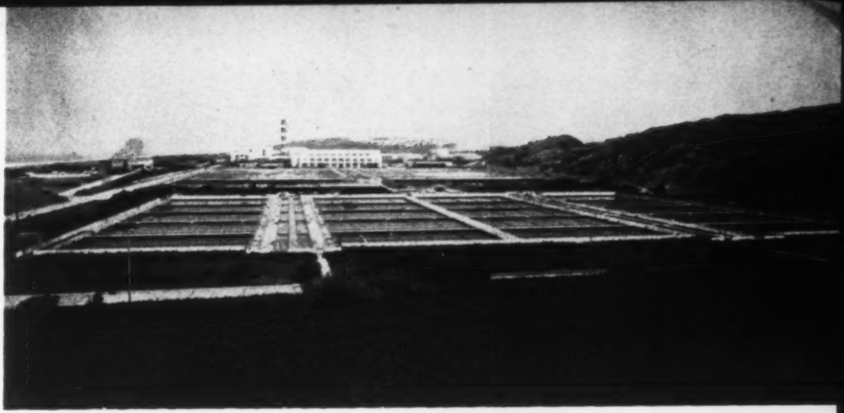

110
100
90
80
70
60
50
40
10
0
Elevation, in feet
Original water level
Water level lowered by first wellpoint set-up
1 000-gpm boil
Excavated to El. 75
Final grade, El. 72
Water level lowered by second wellpoint set-up
Col. 1
Brown very fine organic (Pamlico?) sand
Stiff gray med. and fine sand, some clay
(Brownish gray)
Uniform fine sand, trace of clay (gray)
(Dark gray)
Soft white marl or rock with phosphate pebbles
Col. 2 El.
102
94
89
70
60
52
48
Soil description
Gray to white fine sand
Stiff gray fine sand and some clay
Gray uniform fine sand and trace of clay
4" hard gray clay
Gray to black fine sand, some clay
4" soft limestone
Gray marl to white marl
Gray, shelly, pervious limestone rock
Hard white limestone rock (fractured)
Geologic formation
Pamlico (?) sand
(Pliocene?) Pleistocene sands
Caloosahatchee marl or Hawthorne formation
Hawthorne formation (Miocene)
Transition Hawthorne or weathered Tampa
Tampa limestone (Miocene)
Col. 3
Pleistocene sands
Hawthorne formation
Tampa, formation aquifer

**FIG. 5. Job excavation and known soil conditions when boil broke through are indicated at left. Results of earlier borings are given in Col. 1, those of more accurate composite supplemental borings after blow-in in Col. 2. In Col. 3 are shown typical conditions in area, from Florida Geological Survey Bulletin. Note that Tampa formation aquifer is much deeper than any of the borings. Elevations refer to St. Petersburg City Datum. El. 97.0 = MSL.**

In view of Hyperion Sewage Treatment Plant of Los Angeles, Calif., settling basins are in foreground.



**FINLEY B. LAVERTY, Director ASCE**

**Chief Hydraulic Engineer, Los Angeles County Flood Control District, Los Angeles, Calif.**

# *Recharging ground water with reclaimed sewage effluent*

**W**ater is precious in southern California. The local ground-water basins are seriously overdrawn and supplemental supplies are imported from the High Sierras and the Colorado River over distances of more than 250 miles. The present population is nearly 6.5 million, and by 1975 is expected to exceed 9 million. The California Department of Water Resources has found that 20 out of 35 ground-water basins along the coastal margins of California are suffering from serious sea-water intrusion, or are in immediate danger from it, and that the other 15 are potentially subject to degradation. These factors, and the drought which has continued in southern California since 1944, have led water supply and water conservation agencies to examine every potential source of supply.

One of these water conservation agencies is the Los Angeles County Flood Control District. In addition to its primary responsibility for the County's three-quarter-billion-dollar flood control program, its activities include the salvage of flood and other waste water and protection of ground water.

In view of the fact that over 310,000 acre-ft was discharged to the ocean from sewage plant outfalls in 1948, the County Board of Supervisors asked Sanitation District Chief Engineer A M Rawn, County Engineer C. E. Arnold and Flood Control Engineer H. E. Hedger, all members of ASCE, to report on the possibilities of salvaging these waste waters. Their "Report Upon the Reclamation of Water from Sewage and Industrial Wastes in Los Angeles County" caused the Flood Control District to initiate its studies on the salvage of sewage treatment-plant effluent for ground-water supply.

Salvage of waste waters was not new in the District, which in the early 1930's undertook a program of saving storm waters by diversion to spreading basins for infiltration to underlying ground-water basins. Actually such flood waters often have coliform indices and biochemical oxygen demand values equal to or exceeding those of sewage-treatment-plant effluent. Suspended solids often run into thousands of parts per million, of which the organic part may be appreciable.

Tests in 1948 of the infiltration of effluent from the Whittier Trickling Filter Plant on a silty sand were followed in 1949 with infiltration tests of the effluent of a similar plant at Azusa, Calif., but in the latter case the soil was a coarse sand and gravel. These tests were reported in the ASCE *Transactions*, Vol. 117 (1952), p. 1189. Both test basins were fitted with pits into which samples of the percolating water were drawn from pans under the soil at depths up to 7 ft. These tests demonstrated the practicability of infiltrating, from ponded water in basins, plant effluents of more than 30 ppm BOD, at rates greater than 1 ft in depth per day, without exceeding drinking-water standards at the level of the sampling pan, that is, 7 ft below the basin bed.

## Sea-water intrusion

Among the California ground-water basins that are being spoiled by sea-water intrusion, the most seriously damaged is the West Coast Basin extending from San Pedro northward to Playa del Rey. The elevations at which major wells were pumping in this basin in 1954 are shown in Fig. 1 by ground-water contours. Important aquifers are in contact with the ocean over an 11-mile reach of coastline. Hence, with the steep gradients indicated, it is not surprising that sea water has intruded more than a mile inland, causing the loss of important water-supply wells. Geological studies have shown that the ground-water supply in the West Coast Basin is largely confined by a clay cap which creates a pressure aquifer.

To combat sea-water intrusion here, studies by the California Department of Water Resources, the U. S. Geological Survey, and the Los Angeles County Flood Control District showed that the following five methods were possibilities:

1. Raising the ground-water levels to or above sea level by reduction or rearrangement, or both, of the pattern of pumping draft.
2. Direct recharge of overdrawn aquifers to maintain ground-water levels at or above sea level.
3. Maintenance of a fresh-water ridge above sea level along the coast.
4. Development of a pumping trough adjacent to the coast.
5. Construction of artificial subsurface dikes.

After studying the potential of these various methods, the Flood Control District considered that, for the West Coast Basin, the third method—maintaining a fresh-water ridge above sea level along the coast—offered the best chance of success. This method involved recharging the basin through wells penetrating the clay cap which extends for a considerable distance along the coastline near sea level.

Tests were undertaken at Manhattan Beach in 1950 in a 16-in. cable tool well which had been supplying the beach city until chlorides up to 1,080

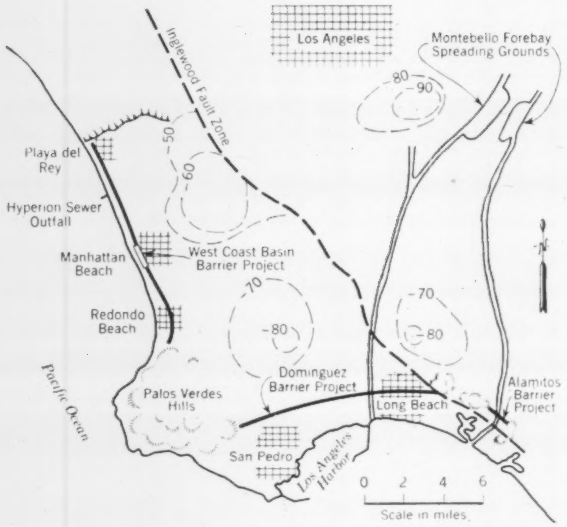


**FIG. 1. Fresh-water barrier project is being carried out at Manhattan Beach in West Coast Ground-Water Basin.**

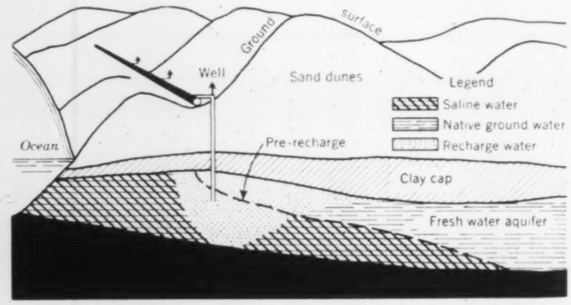


**FIG. 2. Saline intrusion into fresh-water aquifer is blocked after 18 months of recharging with fresh water through well. Fresh-water barrier formed in underground basin shuts off sea-water intrusion, builds offshore gradient and more steeply sloping onshore gradient. Dashed line shows outline of saline intrusion at start of recharging program, before inland movement of sea water was cut off by fresh-water wedge.**

ppm caused its abandonment. Injection of treated Colorado River water into the 8-in. pump column at levels below ground water in this well made it evident that injection could be continuous with sufficient chlorine dosage to throttle clogging slimes created by oxygen-fed, previously dormant organisms in the ground. An article by the writer in Civil Engineering for May 1952, pp. 25-27, describes this test in some detail. With a State grant of three-quarters of a million dollars for a three-quarter mile field test of injection wells, 2,000 ft back from the ocean in Manhattan Beach, injection was started in 1953 in 9 wells 500 ft apart, some standard cased and some gravel packed. The ground level at the wells varies from 70 to 100 ft above sea level and a fine-sand aquifer averages 100 ft thick below the clay cap at sea level.

Though difficulties were encountered with the thin clay cap and techniques of sealing it to prevent loss of pressure-mound water, a sufficient barrier was attained in less than one year to reverse the inland gradient of the sea water and to stop its intrusion along this reach of coast. The test wells were put on a normal operating basis in 1955 and have been operated with little maintenance since that time. See Fig. 2.

## Sources of injection supply

With the success of the experimental barrier came requests from local water supply agencies and civic associations for the study and design of a continuous 11-mile barrier for the West Coast Basin, two additional barriers in the alluvial fills of river outlets along the south coast of Los Angeles County, and also replenishment of the inland Central Coastal Basin. Therefore the Los Angeles County Board of Supervisors requested the Flood Control District to make a thorough study of the facilities required, sources of water, and costs. The locations of the proposed barriers are shown in Fig. 1. Initial estimates of water supplies required for the barriers approach 150 cfs. Just to offset the annual pumping overdraft in the Central Coastal Basin (inland area), without rebuilding its depleted ground water, may require a continuous supply of 225 cfs.

Aside from treated and untreated Colorado River waters, which currently have delivery costs of $22 and $12 per acre-ft respectively, other possible sources of the needed water are the effluent from the City of Los Angeles' Hyperion Treatment Plant, which discharges more than 280,000 acre-ft to the ocean annually, as well as an almost equal discharge to the ocean from the Los Angeles County Sanitation Districts near San Pedro.

To explore the feasibility of using this type of waste-water supply, the Flood Control District obtained the cooperation of the City's Bureau of Sanitation and early in 1955 set up two small spreading basins, each a half-acre in area, together with a preliminary 4-acre-ft sedimentation basin. Water was pumped from the final settling tanks of the Hyperion high-rate activated sludge plant, through the test-area settling basin to the ½-acre test spreading (filter) basins. These contain 12 to 14 ft of very uniform local dune sand, overlying an impervious material on which a perforated collector pipe picks up the percolated effluent for chlorination and ultimate use in a test recharge well. Samples are taken from test wells 20, 50, 70 and 500 ft from the recharge well. The recharge well is 8 in. in diameter, is gravel packed, penetrates a clay cap about at sea level, and is perforated in a 50-ft aquifer of fine sand and a little gravel where sea-water intrusion has raised the chloride content to 14,000 ppm.

During the first year and a half of the test, attention was given successively to:

1. Determining the varying qualities of the high-rate plant effluent
2. Trying various spreading procedures to obtain optimum rates and determine maintenance procedures
3. Attempting to find the best quality of percolating water obtainable for well injection

Continuous spreading developed a good percolate, but an extremely low rate of percolation and eventually an anaerobic condition in the basin bed. Ponding of plant effluent alternating with short periods of drying to maintain an average infiltration rate at 2 ft in depth per day, developed a poorer quality of water with increased maintenance cost for dry raking. Continuous ponding, with raking of the basin bed under water, initially produced a slightly better quality, but still greater maintenance cost. Finally, subdivision of each of the half-acre basins into 8 small basins and rotating applications of water so that each sub-basin was submerged for only one hour out of 24, thereby allowing the basin to thoroughly aerate, produced a continuous average percolation rate for the entire basin of 1 ft in depth per day, together with a percolate having an average suspended solids content of 11.1 ppm and an average BOD of 2 ppm.

Well injection was undertaken during the latter part of 1956 with the percolate from the wet-raking process, chlorinated to achieve a 10-ppm free chlorine residual at the well after a 15-minute detention. This required chlorine dosages ranging from 16 to 23 ppm. This test was followed by percolates from intermittent spreading and other variations, none of which permitted a continuous injection of the 0.3 cfs supplied from the infiltration basin for more than a month without well clogging. However, with the initiation in December 1956 of the intermittent sub-basin spreading and well injection with chlorine residual of but 0.1 ppm, the 50-ft aquifer accepted this water, with its average of 13.3 ppm suspended solids and 1.5 ppm BOD, until the test was suspended in June 1957.

It is considered that this test, together with the laboratory analysis of injected water and water sampled from adjacent wells, adequately demonstrated ability to handle this relatively polluted high-rate plant effluent by a method that permits useful well injection with water meeting drinking-water standards.

During the latter period of these tests, the City lands that were expected to be available for spreading basins were devoted to other uses in connection with the International Airport, leaving the reclamation project with insufficient land to make use of the processes which the test had devised. It is expected, however, that these test results will be quite useful.

During these tests, the City of Los Angeles decided to redesign its Hyperion Treatment Plant to dispose of effluent and sludge through long ocean outfalls after primary treatment. This decision leaves the secondary part of the plant available for standard-rate treatment of a part of the primary effluent. As a result, the District, with the cooperation of the City Department of Sanitation, secured the use of an aeration tank and a clarifier basin for field tests on reclamation of standard-rate effluent. Various "tertiary" methods of treatment using test units, including rapid sand and other filter devices, have been carried out and the report on these will be completed during 1958.

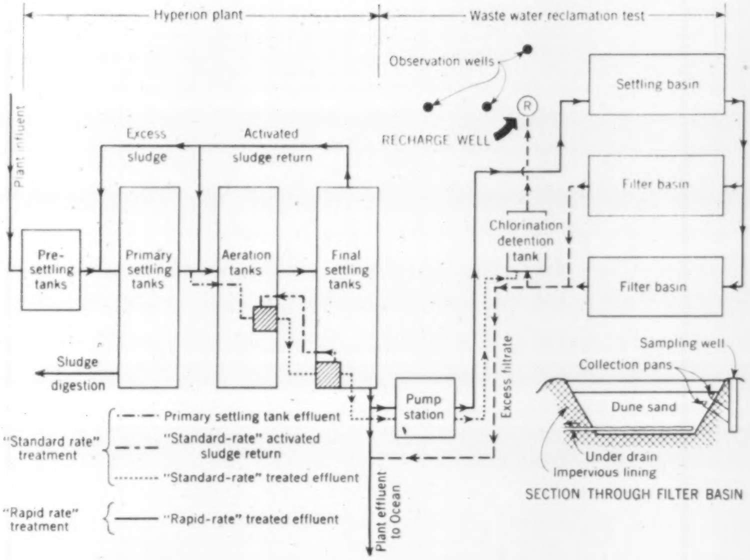

Hyperion plant
Waste water reclamation test
Observation wells
RECHARGE WELL
R
Settling basin
Filter basin
Filter basin
Plant influent
Excess
sludge
Activated
sludge return
Pre-settling tanks
Primary settling tanks
Aeration tanks
Final settling tanks
Chlorination detention tank
Sludge
digestion
Pump station
Excess filtrate
"Standard rate" treatment
Primary settling tank effluent
"Standard-rate" activated sludge return
"Standard-rate" treated effluent
"Rapid rate" treatment
"Rapid-rate" treated effluent
Plant effluent to Ocean
Sampling well
Collection pans
Dune sand
Under drain
Impervious lining
SECTION THROUGH FILTER BASIN

**FIG. 3. Schematic diagram shows flow through Hyperion activated sludge plant and District waste-water reclamation test.**

To summarize, the various tests that have been carried out show that where enough land of proper infiltration characteristics is available, trickling-filter-plant effluent can be spread economically so as to create no pollution to the ground water when the latter is more than 7 ft below the surface; and that high-rate activated-sludge effluent, generally varying from 30 to 80 ppm in suspended solids and BOD, can be sufficiently treated through special spreading techniques to furnish a percolate which, when chlorinated, can be injected into a well, with no important maintenance problem and without polluting the ground water. Whether polishing treatment, using only four or five acres for 100 cfs, will be both successful and economical remains to be determined by the current tests with standard-rate effluent. It has been found that the standard-rate effluent cannot be injected into a well directly. Some economical polishing treatment is essential.

Varying conditions at each sewage treatment plant where tests have been run have been found to warrant a note of caution as to the broad application of test findings.

To return to southern California's ground-water problem, some progress has been made toward supplementing with reclaimed water the imported supply now used to replenish ground water. These imported supplies are expected to become short of satisfying the demand, because of the tremendous growth in population and industry, before water can be secured from water-rich northern California. Hence, the use of reclaimed water bids fair to play an important part in southern California's water supply after sufficient research to discover more of its possibilities.

The forward looking concepts of the Los Angeles County Flood Control District's Chief Engineer, H. E. Hedger, and Assistant Chief Engineer Paul Baumann, both Members ASCE, have made this experimental work possible. The work is being done by the District's Hydraulic Division and is directed by the writer. Part-time consultant on it has been Ralph Stone, M. ASCE.

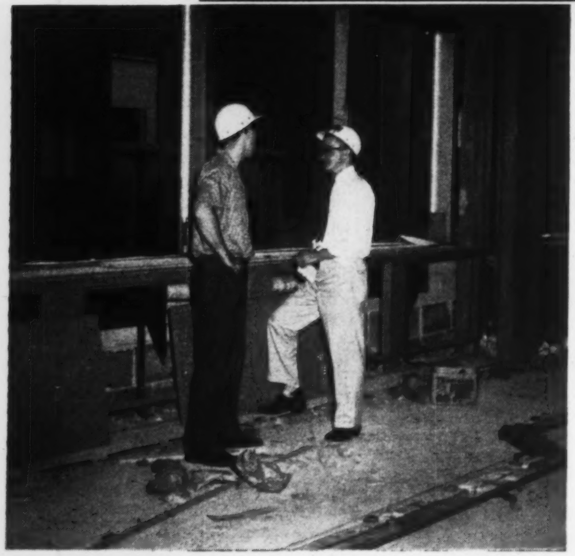
This research program was under the immediate supervision of H. A. van der Goot, A.M.ASCE, until his death recently. It is now supervised by A. E. Bruington, J.M.ASCE, and A. A. Ingram. The District is indebted to the Director of the City of Los Angeles' Bureau of Sanitation and his Assistant —Warren Schneider, A.M.ASCE and Norman Hume, M.ASCE, respectively —and to G. A. Parkes and Robert Bargeman, Chief Engineer and Assistant Chief Engineer of the Hyperion Treatment Plant, as well as to the Director of the Plant's laboratory, William Garber, A.M.ASCE, for complete cooperation in carrying on the field and laboratory work.

New look in buildings is shown by:
(1) Hotel Statler, Hartford, Conn.
(2) Mile-High Center, Denver, Colo.
(3) Lever House, New York, N. Y.
(4) Aluminum Company of America Building, Pittsburgh, Pa.
(5) Illuminating Building, Cleveland, Ohio

Aluminum frame set outside the structure carries the all-glass facade of the Corning Glass Company Building in New York.

**PETER P. F. DEJONGH**
**Chief Structural Engineer,**
**George A. Fuller Company,**
**New York, N. Y.**

All glass is fixed and is continuous past the floors. Cleaning will be done from a scaffold operating in tracks on the frame.



Mock-up of Carrier Modular Weathermaster unit in Corning Glass Building is explained by Ken McKenna of Fuller (left) to Frank Schneller of "Civil Engineering."

Buildings have taken on a new look in the past decade. Metal and thin-wall back-up, with more glass, have completely changed the facades of the new buildings that are rapidly lifting the faces of many cities. This construction is more expensive than brick, and the large glass areas increase air conditioning costs. But people like the new look.

Until recently masonry was the principal material for the exteriors of buildings. Individual stones or bricks have been laid one on top of another to express the esthetic conceptions of architects since prehistoric times. In recent years there has been some use of metal for window and door frames and occasionally for copings and a few other ornamental treatments.

Before 1946 metal facades were used only to a very limited degree despite a few outstanding examples. In that year the Aluminum Company of America started a big research program by commissioning the George A. Fuller Company to develop practical methods for the use of aluminum as a building facade material.

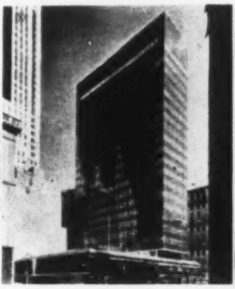
Out of this research came, in 1948, the first all-aluminum metal-glass facade—for the Alcoa Office Building in Davenport, Iowa. This building proved that thin-wall construction was practical although there was a need for improvement in details. In the same year, a true application of aluminum in curtain-wall construction was made on the Equitable Savings and Loan Association Building in Portland, Oreg. This building has no masonry above the ground floor.

The basic requirements for a metal-glass facade are:

1. Light weight
2. Ease of erection
3. Weathertightness

1

2



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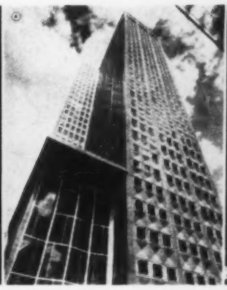

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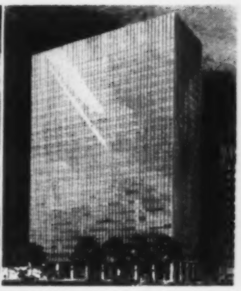


5

# The new look in buildings

4. Provision for expansion and contraction
5. Conformity with building codes

In 1948 most cities required a spandrel wall having a 4-hr fire rating. An 8-in. brick wall would satisfy this requirement, but brick weighs 120 lb per cu ft. Since light-weight construction was important, a back-up wall 4 in. thick (either precast or poured) made of diacrete and cement was developed, weighing 20 lb per sq ft compared to 80 lb for an 8-in. brick wall. The back-up wall was not too expensive—around $1.20 per sq ft at that time. Now other materials, such as perlite, are used successfully. Today the 4-hr fire rating requirement has been lowered to two hours in most cities. Some localities waive this and require only that walls be made of non-combustible materials.

Light-weight construction, in many instances, brought savings in the structural frame as well as in building costs. A simple example will illustrate this. A 16-story building first designed with a 4-in. limestone exterior backed up with 8 in. of common brick was later redesigned with an exterior facade of aluminum spandrels and a 4-in. light-weight spandrel wall from floor to sill. Columns were spaced at 20 ft, story height was 11 ft 6 in., and the glass area was 30 percent of the facade area. The result was a reduction of about 19,000 lb in weight per bay or, for 16 stories, 150 tons per column. Using 30-ton piles, this permitted a saving of five piles per column. Structural spandrel beams as well as exterior columns were also somewhat lighter.

Another advantage of thin-wall construction is that the overall wall thickness can be reduced by as much as 6 in., affording an increase in rentable area. In a 100 x 100-ft building, this can amount to 400 sq ft per floor and a 4-percent increase in income. This consideration must be included in the overall analysis of building costs, especially as it normally does not show on construction estimates.

Ease of erection is important. In most cases, facades made of metal can and should be erected from the inside of the building, thus avoiding outside scaffolding. This item can create large savings in both time and money. Weather conditions become of little importance, and a minimum of time is lost. This contrasts with earlier operations which were practically brought to a stop by adverse weather conditions. Since metal frames are light, they can be handled easily by a few men without resort to expensive equipment.

But this new construction also involves problems, some of them common to older materials. Most troubles are being alleviated by study, development and cooperation. One continuing problem is building tolerances. Structural steel and its fireproofing are not built to exact dimensions. Columns are not perfectly plumb. However, the building facade cannot be permitted to weave in and out. Normally facades are supported by clips or brackets fastened to the structure. These clips are set to an exact line by the use of slotted holes, inserts, etc. Erection procedures may vary depending on the type of job and the erector's method and equipment. No matter what the method, the erection of the facade should be completely controlled by the manufacturer and should be made a part of his contract.

Weather tightness is essential. Joints should be treated to shed water, and their number kept to a minimum. Generally they are located at expansion joints, at mullions, and at ceiling and floor levels. Today panels are mostly one story high and extend the full width between vertical mullions. Weather tightness is generally attained by use of neoprene gaskets or calking compounds. Thiokol has been found a satisfactory compound.

Thiokol has a polysulfite synthetic rubber as the base material, to which is added an activator. The base material is a patented product produced by the Thiokol Chemical Corp. This is used by several companies making finished Thiokol compounds. Thiokol can be applied by the gun method. The pot life of the material is two to four hours. If it sets in the extrusion gun, it is practically impossible to remove. Thiokol adheres very strongly to glass, metal and porcelain. Care must be taken that no oil or waxy substance be left on the surfaces to be treated. The preparatory cleaning of surfaces must be thorough and effective, with chemicals. It does not suffice to brush off the dust and debris or scrape off hardened mortar. Frequent inspection of cleaning procedures is recommended. Thiokol is expensive—$25.00 per gal—and must be handled with skill to avoid excessive cost.

Glazing is an important part of water and air tightness. No matter how tight metal-to-metal joints are made, if inferior glazing is tolerated, the building may have leaks. Although glazing is usually done under a separate contract, general contractors often include this item as part of the facade manufacturer's responsibility. In that way only one party is responsible.

Another cause of water infiltration is condensation, which forms on the inside of metal walls. Water should be led out by condensation gutters at each sill and by the use of flashing leading to the outside through weep holes. The installation of flashing should be part of the facade manufacturer's responsibility. It cannot be emphasized too often that the manufacturer should erect the facade and have under his supervision the installation of all the component parts of the exterior wall.

All materials used for the facade are subject to damage during erection. Surfaces should be protected as much as possible. It is recommended that no exterior metal be erected until all concrete floors are poured. This may not be practical when buildings are 40 to 50 stories high; in such cases protective scaffolds are recommended below the floors to be poured.

There should be no maintenance cost as far as metal-glass facading is concerned except window cleaning, which deserves consideration. Two methods are commonly used:

1. Use of reversible or in-swinging windows
2. Use of outside window-washing scaffolding, running up and down the facade, in which case mullions are designed to provide guides for the scaffolding and the glass in all windows can be fixed

This last method has proved very economical, even when the costs of scaffolding, structural support and operation are included. Cleveland's new Illuminating Building uses this method, as well as Seagram's and Lever House in New York.

There are many types of metal-glass facades, providing a wide range for the selection of pleasing variations. Several materials can be used to add color:

**Porcelain enamel** is commonly used for spandrel and column facing. Colors are fast and generally not too expensive. Flat panels of large area should be avoided. The so-called "tin-can" look can be avoided by specifying a textured color such as that used on the Dallas Statler.

**Aluminum** can be used for the entire facade—windows, mullions and spandrels. Aluminum can be colored or even porcelainized and is fabricated in the form of castings, plate, or extrusions. Plates can be flat, formed, or stamped in various designs. Extrusions are used for window and mullion sections or even for spandrels. Spandrels may be of any of the forms described. Most aluminum for buildings is alumilited or anodized (an oxidizing process) to give it a more durable surface.

**Stainless steel** is being used more and more. As of today, it cannot be extruded and shapes must be formed on a break, or by rolling or stamping. It can be porcelainized, and rigidized sheets provide an attractive design pattern.

**Bronze** can be extruded in limited sizes and shapes but has not been widely used because it is expensive. The Seagram Building in New York has an all-bronze facade that required so much metal three producers were needed to manufacture all of it.

Facades can be of various designs. One metal can be used throughout or several can be used in combination. It is not unusual to see aluminum and porcelain enamel mixed, or stainless steel and porcelain enamel, or stainless steel and aluminum. Frequently we find an aluminum facade above the second floor and stainless steel below. Whether one scheme or another is used, field problems are similar. The more metal and the more complex the design, the greater the cost. The spacing of mullions as dividing lines between windows naturally affects the price. The larger the modular system, the greater the economy. There are fewer pieces to fabricate, crate, uncrate and erect.

But there are size limitations. For instance, no panels should measure more than 10 ft in any direction. The use of porcelain enameled sheet for panels is limited to the furnace sizes of the manufacturers; with aluminum the size of alumiliting tanks is a factor. All these items should be considered in the final design.

Insulated panels are commonly used for spandrels, column covers and mullions. A definite *U* factor of heat transference is specified and panels are designed to meet these specifications. The new Hilton Hotels used a porcelain enameled exterior spandrel face blacked with $\frac{1}{8}$ in. of fiber-cement Transite, 1 in. of Fiberglas and an interior sheet of Transite, to be painted. The edges were taped, and pressure relief outlets were provided at the bottom of panels. Other panels may have an aluminum or stainless-steel face, with a paper or aluminum honeycomb core.

How much does a metal-glass facade cost as compared to a wall of brick masonry? It is more expensive, but how much more it is impossible to say until estimates of comparable plans are made. The average metal-glass facade for commercial buildings should not cost more than good limestone treatment. Buildings that are erected as a monument to the owner can cost plenty.

About $4 per sq ft is usually a minimum for facades generally, covering the cost of an aluminum grid system. To this must be added glass and glazing for windows, glass or metal spandrels, back-up walls, stools and convectors, pockets for Venetian blinds, enclosure pieces (from mullion to exterior), wide column covers, painting, and special designs such as large vertical fins for sun control, or sun canopies.

Close cooperation among the architect, engineer and contractor during the design stage is essential to achieve greatest economy. Materials, methods and budgets can be worked out for acceptable treatment of the facade. The architect, being an artist as well, will envisage certain shadow lines for his facade treatment and will justly insist that these be maintained. However, there are many ways to put the pieces together and still achieve the desired architectural features. Methods of assembly greatly influence cost. Sometimes even a slight variation in the width of a mullion, a sill, or head may have a great effect. In one case an extra inch in the width of the mullions reduced costs considerably.

Increased glass in facade areas may greatly increase the cost of air conditioning. The Lever House type of construction, for instance, is repeated in the new Time-Life Building now under construction in Rockefeller Center. In the old Rockefeller Center buildings, the glass area is 28 percent of the facade, whereas in the Time-Life Building, glass accounts for 44 percent. This is an increase of 57 percent in glass area, which will require 180 tons more of air conditioning. At $1,300 a ton, that represents an appreciable increase in cost.

No matter how carefully a facade is designed, details must be worked out by the manufacturer. And even though he has to guarantee that the building will be weather tight, the costs should include a mock-up before large-scale manufacturing begins. The mock-up is a full-size sample of the design and should be tested for water and air infiltration, for deflections and structural deficiencies. The written specifications should be very clear as to what is required.

The future of curtain walls can be unlimited. On Park Avenue in New York, the new buildings are designed for the curtain-wall type of construction. Throughout the country all new buildings seem to employ some form of light wall. This can be expected to continue because of economy and appeal to owners and tenants.

Increased research by manufacturers is developing improved methods of shop handling and field erection that create savings in labor costs. Today there are many manufacturers in the business, and competition is healthful. The large selection available in design and color tends to create a greater desire for curtain-wall construction.

The High Aswan Dam

# A basic step towards full utilization of the river Nile

**DR. MOHAMED A. SELIM, M. ASCE**

**Member, Board of Directors of the High Dam Authority, Cairo, Egypt**

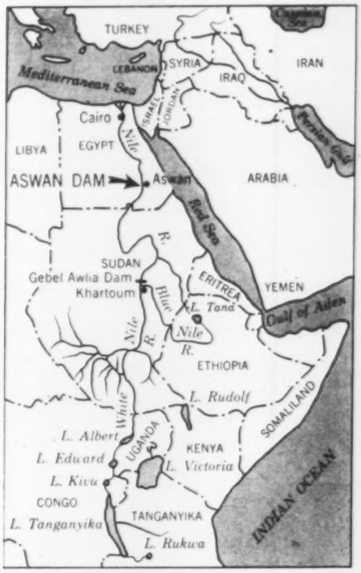


FIG. 1.

**A**ll along the Nile's 6,700 kilometers (4,160 miles), from its most remote source near lake Tanganyika to the Mediterranean Sea and over the 2.9 million sq km (1.1 million sq miles) of its basin and even outside, people are affected to some extent by the river and its waters. See Fig. 1. In East and Central Africa, transport, power, crops and drinking-water are concerned; in the Sudan, transport, drinking water, and some irrigation. In Egypt, where rain is very scarce, it is the whole life of the country, and away from it there are only a few oases.

The basin system of irrigation which was the basis of Egypt's wealth and power for thousands of years, made use of the flood waters coming down between July and October or early November. This type of irrigation was suitable only for the cultivation of crops that grow in the warm Egyptian winter, such as wheat, barley and beans. In the nineteenth century the perennial system was developed by the construction of control dams in the Delta. This considerably increased the production of summer crops, notably cotton. These dams, however, were designed to raise the water level only sufficiently to feed an extended system of irrigation canals; they could not increase the total amount of water available at any time of year.

The original Aswan Dam, completed in 1902 and since twice heightened, was designed to impound water during the annual flood season for use in irrigation during the following dry season. It greatly enhanced the usefulness of the control dams, and five more were built later. As a result, Egypt's production of cotton increased from 350 million lb in 1890 to 1100 million lb in 1938. The present average annual production of 800 million lb is the result of government restrictions on cotton cultivation.

The existing Aswan Dam only impounds the tail end of the flood, when the silt content of the water is much reduced. During the peak flood period, all water is passed through the sluices; otherwise the reservoir capacity would gradually be reduced by sedimentation. The stored water is released in the following low-water season to supplement the natural summer flow. In a normal year, the natural river supply, together with the water stored at Aswan and Gebel Awlia dams, is just enough for present requirements, while in a below-normal year it is short of these requirements. In a very low year, the natural river supply may not fill the reservoirs.

Following Joseph's example in his handling of corn in Egypt some thousands of years ago, the Government of Egypt plans, by the construction of the new high Aswan Dam, called Sadd-el-Aali, to store water in good years to meet the shortage in bad years, a process known in engineering as over-year storage. The reservoir capacity will be such that it will annually guarantee for Egypt and the Sudan enough water to meet their present agricultural demands and at the same time permit a considerable expansion of agricultural lands in both countries.

During a high flood the discharge at Aswan on the main Nile may be as high as 1,100 million cu meters a day (450,000 cfs) or, in a low year it may not reach half that rate. The arithmetical mean of the total annual supply during the past 55 years is 84,000 million cu meters (68 million acre-ft).

The natural river supply also varies from day to day, normally carrying from 700 million cu meters per day (300,000 cfs) during periods of surplus to 70 million cu meters per day (30,000 cfs) during periods of shortage.

After providing for unavoidable losses by evaporation and seepage, the net draft of Sadd-el-Aali reservoir is computed to be 70,000 million cu meters (56 million acre-ft). The calculation is based on current theories of over-year storage for a reservoir live storage of 70,000 million cu meters (56 million acre-ft) and corresponds to the amount of water that can be used at Aswan in any year irrespective of the flood height. The gross capacity of the reservoir will be 130,000 million cu meters (104 million acre-ft), of which 30,000 million cu meters (24 million acre-ft) will be reserved for flood protection and the same amount for sedimentation (dead storage).

The guaranteed net annual draft from Sadd-el-Aali will therefore be about 30 percent in excess of the present requirements for Egypt and the Sudan. This water, which will literally be saved from that now being wasted to the sea every year, will be used in the development of 2 million acres of agricultural land in Egypt and of about double the present agricultural land in the Sudan.

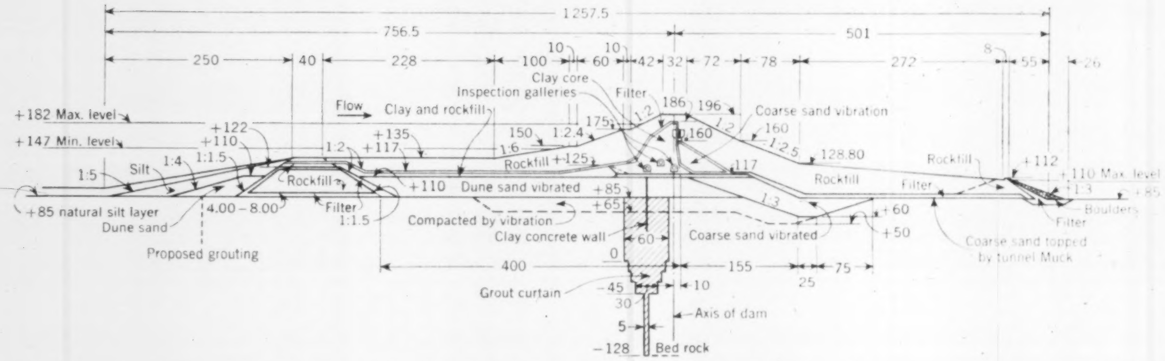

1257.5
756.5
501
250
40
228
100
10
60
10
42
32
72
78
272
8
55
26
Clay core
Inspection galleries
Filter
Flow
Clay and rockfill
+182 Max. level
+147 Min. level
+122
+110
+135
+117
1:2
150
1:2.4
175
186
196
1:2
1:2
Coarse sand vibration
160
160
1:2.5
128.80
117
Rockfill
+125
1:6
1:5
Silt
1:4
1:1.5
Rockfill
+110
Dune sand vibrated
+85
+65
Rockfill
Filter
+112
+110 Max. level
1:3
+85
Boulders
Filter
1:3
+60
+50
+85 natural silt layer
Dune sand
4.00 – 8.00
Filter
1:1.5
Compacted by vibration
Clay concrete wall
60
Coarse sand vibrated
Coarse sand topped by tunnel Muck
Proposed grouting
0
400
155
25
75
Grout curtain
–45
10
30
Axis of dam
5
–128
Bed rock

FIG. 2. Design of dam is based on sand foundation with grout curtain extending down to bed rock, for depth of nearly 700 ft. Maximum pool of existing Aswan Dam is about at El. 121. Figures are in meters. (1 meter = 3.281 ft.)

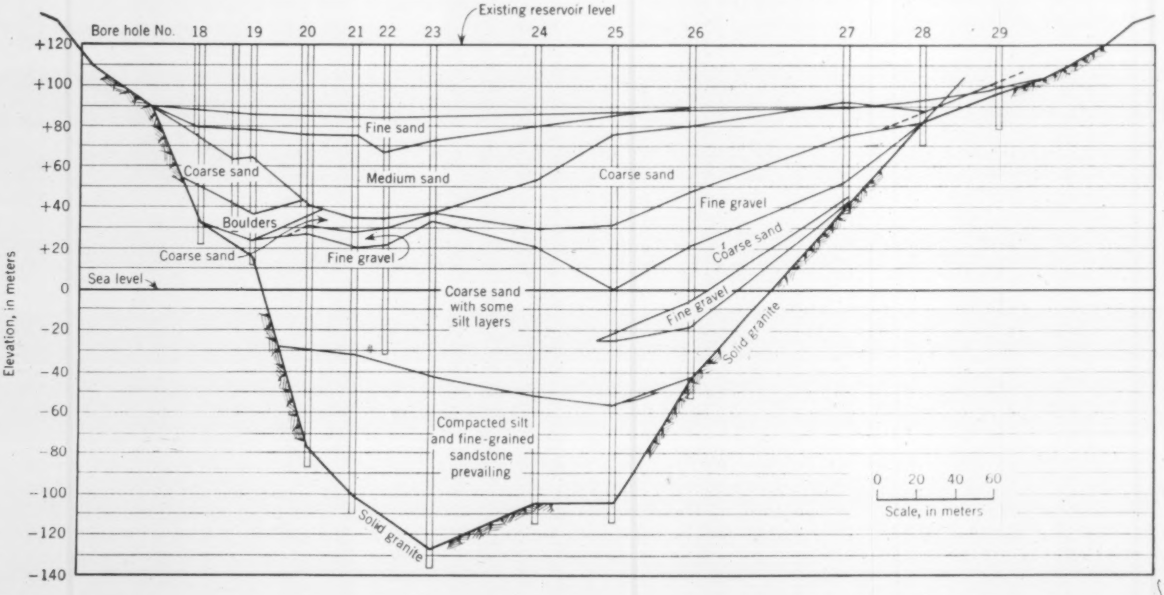
Two years of hydrologic, geologic and topographic investigation of the 50-km (31-mile) reach of the Nile upstream of the existing Aswan Dam, led to the choice of the Sadd-el-Aali site 6 km (3.7 miles) south of the Aswan Dam. The site has the advantage that both its banks consist of sound rock and rise steeply from the river bed, so that a dam of only moderate length is required. The river at this location has a width of 500 m (1,640 ft) and the rock on both banks is of a nature suitable for the construction of tunnels. However, there are numerous sedimentary deposits on the rock bottom of the river reaching a depth of about 213 m (700 ft) at the center, and the design of the dam is consequently based on a sand foundation. See Figs. 2 and 3. Because of this pervious foundation additional precautions have been taken, and the final design has more than one line of defense against the danger of excessive seepage.

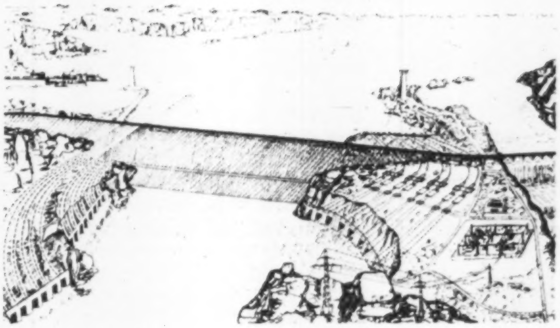
Of course the entire flow of the Nile will have to be diverted during construction of the High Dam. Through the rock of the east bank, seven diversion tunnels will be cut, and a cofferdam will be constructed both upstream and downstream of the main dam site so that the foundations of the main dam can be placed in still water. The cofferdams will remain as an integral part of the new dam.

Each diversion tunnel will be rectangular in cross section with a semicircular arch top 15.5 m in diameter and quarter circular bottom corners 3 m in radius, the total width of cross section being 15.5 m and the total height 16.5 m (about 51 x 54 ft). The tunnels are designed to pass all the natural river water during a high flood and also to control the passage of water for irrigation during the summer. For the latter purpose, the tunnels will be equipped with regulating gates.

After completion of the main dam, the tunnels will also be used to control the flow for irrigation by supplementing the water passing through the generators. In the event of war, the diversion tunnels can be used to rapidly lower the reservoir to a reasonably safe level. Each of these functions is at a different head of water and under different conditions of upstream and downstream levels. The performance of the diversion tunnels under all conditions, their efficiency and economical alignment, the shape and type of their

FIG. 3. Sedimentary deposits in river bed are nearly 700 ft thick, as numerous borings have shown.


Existing reservoir level
Bore hole No.
18
19
20
21
22
23
24
25
26
27
28
29
+120
+100
+80
+60
+40
+20
0
-20
-40
-60
-80
-100
-120
-140
Elevation, in meters
Fine sand
Medium sand
Coarse sand
Coarse sand
Boulders
Coarse sand
Fine gravel
Fine gravel
Coarse sand
Sea level
Coarse sand with some silt layers
Fine gravel
Compacted silt and fine-grained sandstone prevailing
Solid granite
Solid granite
0
20
40
60
Scale, in meters



Sketch of High Dam shows arrangement of diversion tunnels at left, and underground powerhouse at right. Railroad (upper left) will deliver goods above dam for water transport.

Terrain at top of west bank of Nile, near site of emergency flood spillway for high Aswan Dam, is examined by members of Aswan Dam Consulting Board.

intakes and outlets, and their gates and gate grooves, are being checked by extensive hydraulic model experiments. Since the main dam cannot be started until the diversion tunnels are completed, it is intended to start the excavation of the tunnels as soon as the hydraulic model tests are completed.

Of the seven diversion tunnels, four will have their intakes close to the river bed while the intakes of the other three will be about 20 m (66 ft) higher. Since the tunnels will be entirely in chemically sound granite, they will be lined only where jointing requires.

The upstream cofferdam will serve to divert the Nile's waters into the diversion tunnels during construction of the high dam. In itself, it will be a storage dam with a height of 50 m and a length of about 600 m (164 x 1,970 ft), built in water 15 to 35 m deep (50 to 115 ft). For this reason generous cross-sectional dimensions are allowed.

The cofferdam will consist of a rock-fill core with graded rock-fill filters on both the upstream and the downstream face. The substrata consist of silt which, it was thought originally, would have to be compacted by vibration and possibly also by the explosive method. However, field investigation has proved that the substrata do not need any artificial compaction.

On the upstream side, the rock fill supports a wedge-shaped body of compacted dune sand serving the purpose of reducing the seepage through the cofferdam to a tolerable value. At the upstream toe of this sand, there will be a cutoff curtain probably extending about 65 m (213 ft) down into the river bed. This curtain will be built by drilling and grouting under pressure with a grout mixture developed by field tests. Clay will be the main component of this grout, which will probably also contain a small amount of cement.

The river will probably help to make the cofferdam watertight by depositing silt against its upstream side while it is under construction. Its construction is expected to take four years. Work the first year will be carried out in the full depth of water. The cutoff curtain will be built during this year. In the second year, during the period of low flow, the first 10 m (33 ft) of the cofferdam will be placed under water. In flood, the level in the existing reservoir will be adjusted so as to limit the velocity of flow over the cofferdam to a safe

Test boring is under way in Nile River at Sadd-el-Aali site of high Aswan Dam. All photos were taken by Lorenz G. Straub, M. ASCE, of the Consulting Board.

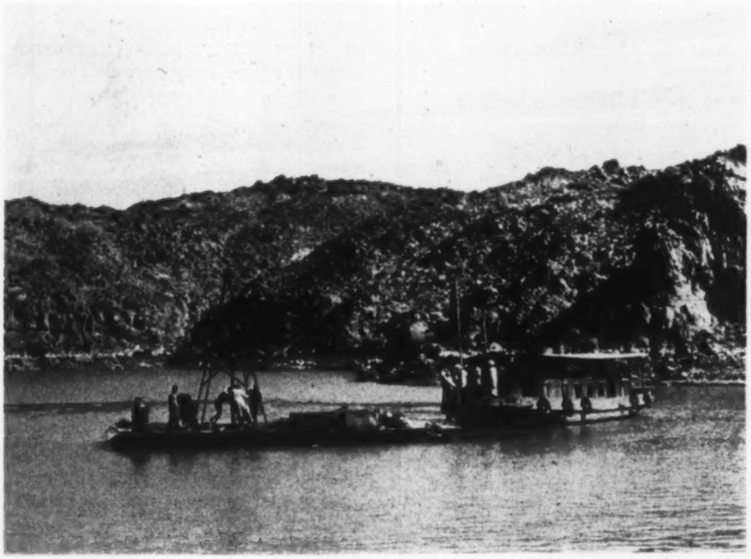
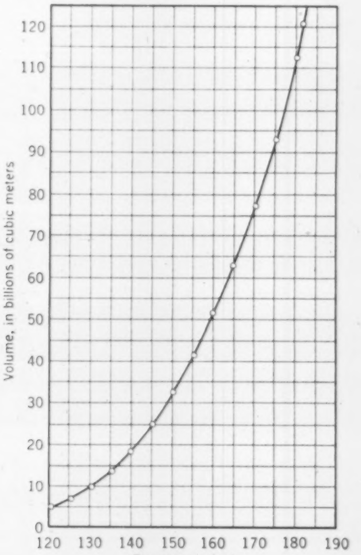


FIG. 4. Reservoir capacity of new Aswan Dam. 1,233.4 cu m = 1 acre-ft.



### High Aswan Dam (Sadd-el-Aali)

| | | |
|---|---|---|
| Height above river bed | 110 | m (360 ft) |
| Length | 5,000 | m (16,400 ft) |
| Width of base | 1,300 | m (4,265 ft) |
| Capacity of reservoir | 130,000 | million $m^3$ (105.4 million acre-ft) |
| Excavation in rock | 17 | million $m^3$ (22 million cu yd) |
| Ironwork | 34,000 | tons |
| Volume of materials of construction | 42 | million $m^3$ (55 million cu yd) |
| Diversion tunnels (east bank): | | Seven |
| Length of each | 2,100 | m (6,900 ft) |
| Section of each | 15.5 x 16.5 | m (51 x 54 ft) |
| Power tunnels (west bank): | | Four |
| Length of each | 1,500 | m (4,920 ft) |
| Diameter of each | 13 | m (43 ft) |
| Turbines: | | Sixteen |
| Capacity of each | 120,000 | hp |
| Annual energy production | 10,000 | million kwhr |
| Estimated cost of dam including indemnities | £E.120 | million (344 million dollars) |
| Cost of production per kwhr at Aswan | £E.0.005 | (1.44 cents) |
| Estimated time for construction | 10 | years |
| Estimated time for beginning of water economy | 5 | years |

## ECONOMICAL BENEFITS OF PROJECT

### Benefits to Egypt

**Expansion of cultivation on 2 million acres, thus increasing the present cultivated area by 30 percent**

**A guarantee of sufficient water for the whole area under cultivation, even in years of low supply**

**Improved drainage conditions in cultivatable areas**

**Ensured cultivation of 725,000 acres of rice yearly**

**Complete protection against high floods**

**Improved hydraulic conditions upstream of the existing Aswan Dam, almost doubling the electric energy generated**

**Improved navigation conditions**

**A guaranteed head of water on existing control dams where hydroelectric power can be produced**

**A hydroelectric potential which will be utilized to produce 10 billion kwhr of power a year**

**A reduction in annual consumption of fuel oil by about two million tons**

**An increase in annual Government income of £E.23 million (66 million dollars)**

**An increase in annual national income of £E.355 million (1,020 million dollars)**

### Benefits to the Sudan

**Doubling of the present agricultural acreage**

**Guaranteed water requirements for the whole area under cultivation even in years of low supply**

**A large-scale development in cultivation of long staple cotton**

**An increase in annual national income and of federal income from agriculture of about 200 percent**

**Development of hydroelectric power from its share of water impounded by Sadd-el-Aali**

**Guaranteed long life for reservoirs of Sudanese dams, since they will be filled by more or less clear water and there will be virtually no reduction in their capacities by sedimentation**

value. Four of the diversion tunnels should be ready before the following flood season, that of the third year of construction, to relieve the cofferdam from excessive erosion by overflow. The cofferdam will be raised during that year to a height of 20 m (65 ft). Finally, by the end of the fourth year, the cofferdam will reach its full height of 50 m (164 ft) above the river bed. By this time all the diversion tunnels must be completed to divert the entire river flow.

The downstream cofferdam, to be constructed during the fourth year, will have an apron of large boulders on the downstream side for protection against scour by the water leaving the diversion tunnels. The final designs for outlets and required stilling basins for these tunnels are being determined at present by hydraulic model study.

The crest of the main dam will be 110 m (361 ft) above the river bed, and its length will be 500 m (1,640 ft) at the river bed and approximately three miles at the crest. The dam will be a rock fill equipped with a clay core roughly triangular in section and 90 m (295 ft) wide at the base. It is protected against failure by two independent lines of defense, an upstream blanket and a grout cutoff.

The grout curtain serves the exclusive function of safeguarding the integrity of the downstream section of the dam in the event that the blanket is badly damaged by bombing. This grout curtain will be placed while work is in progress on the diversion tunnels and upstream cofferdam. At the center of the river, it will be extended to a depth of about 200 m (656 ft).

Towards the downstream toe of the dam a large trench will be excavated under water to a depth of 25 m (82 ft) and will be filled with coarse sand. This will act as a filter to prevent piping under the dam caused by percolating water carrying away fine silt from the river bed.

The whole extent of the main dam foundation will be covered with compacted dune sand 25 m (82 ft) deep.

A plastic curtain of clay concrete will extend from the top of the dune sand down about 35 m (115 ft) into the grout curtain, while a horizontal blanket of clay will be laid on top of the dune sand extending from the clay core to the upstream cofferdam, a distance of about 400 m (1,300 ft) with a layer of rock-fill 20 m (65 ft) deep above it for protection.

Three inspection galleries will be built into the clay core. One will be immediately above the plastic clay curtain so that it can be used for maintenance of the curtain. The other two will be placed further downstream and will be used for inspection, measurements, and maintenance of the grout curtain throughout the life of the dam.

In the event of war involving the possibility of an air raid, the water level in the reservoir will be kept a safe distance below the crest of the dam. Furthermore the crest of the dam is protected by a heavily reinforced concrete wall of 16 m (52 ft) deep adjacent to the downstream face of the core. On account of these provisions, destruction of the dam itself by bombs other than atomic is impracticable. The bombs would damage only the upstream blanket. Such damage would only increase the loss of water by seepage through the dam, but the dam would remain intact and the loss of water could again be reduced by supplementary grouting from the inspection galleries or other means adapted to the nature of the damage.

Four tunnels and power plants will be located on the west bank of the Nile. These tunnels, unlike those for diversion, will be lined with concrete to minimize energy loss by friction.

The underground power plants will have 16 turbine units, each capable of developing 120,000 hp (or about 90,000 kw). Of the 16 units ultimately provided for, 8 will be installed initially. A restudy is now under way to assess the desirability of installing larger turbo-generators than originally planned, perhaps 130,000 to 175,000 kw, while maintaining the total capacity of the first stage, to be built during the initial ten years, at about 720,000 kw as originally planned, to generate 4.3 billion kwhr annually.

In 1954, the total power consumption in Egypt was 1,300 million kwhr. The forecast for 1960, taking into account the set program for industrial development, gives an expected power demand of 3,300 million kwhr. It is further expected that the demand will be doubled by 1970 and doubled again by 1980. These figures indicate that the country can absorb all electric power produced by the High Dam in addition to that from the power station now under construction at the existing Aswan Dam.

The turbines will be placed on the west bank of the river in chambers excavated in the rock below the dam. Intakes to the power tunnels will be placed in a convenient depression immediately upstream of the dam, and the tailwater will be discharged into a bay about half a mile downstream. Transformer stations will be placed underground, immediately downstream of the power chambers. The main transmission cables will be led by shafts to the switching station overhead.

The inlets to the four primary power tunnels will be in the immediate vicinity of the upstream toe of the dam. The four power-station caverns will be placed deep in the granite in the left bank of the Nile, with their longitudinal axis in a straight line and approximately on the axis of the dam. The site of the intake tunnels, at El. 130 m (426 ft) above sea level, is fixed in relation to the minimum upstream reservoir level of 147 m (422 ft).

The power water tunnel of each of the four caverns will be circular with a diameter of 12.7 m (42 ft) bifurcating into two tunnels of 9-m (30-ft) diameter leading to the gate chambers. From there, they again bifurcate into 6-m (20-ft) tunnels each equipped with a butterfly valve to control the inlet of water to the separate turbines. Each power station will have two surge tanks. The water discharged from each pair of turbines will be collected on the downstream side into tailwater tunnels of 11.5-m (38-ft) diameter.

Each cavern will be equipped with two overhead 150-ton cranes. Air conditioning equipment is included in the design. Each of the four transformer caverns will be equipped with 8 single-phase transformers of about 85,000 kw each. The installation includes a stand-by for each three transformers in service. Transformation will be from 15 to 500 kv, with provision for transmission at the latter voltage to Cairo, a distance of approximately 770 km (480 miles) away.

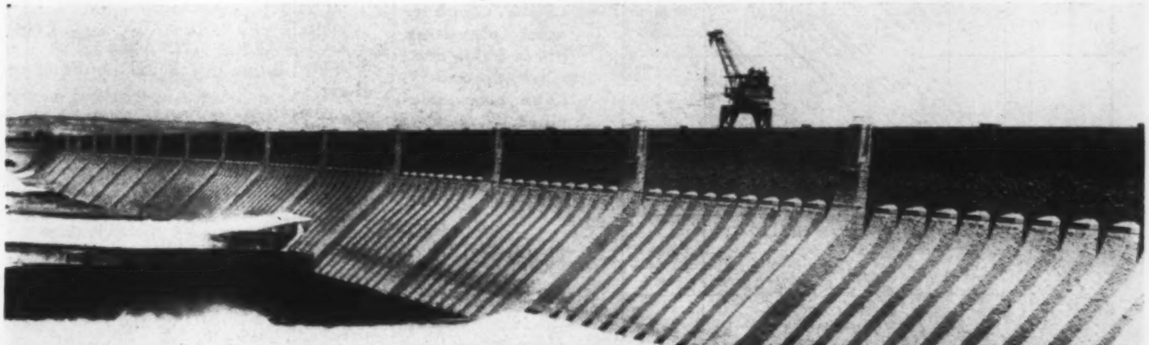
The core and blanket for the dam will be made of Nile clay of which two large deposits are available near the site.

All in all there will be about 42 million cu m (about 55 million cu yd) of material in the Sadd-el-Aali. Dune sand, which constitutes a large part of this volume, is available in unlimited quantities on the west slope of the Nile Valley. Granite rock-fill will be transported from tunnel excavation. Fully adequate coarse-grained filter will be obtained by dredging from the river bed or by screening from the tunnel muck, or both.

Estimated reservoir volumes are given in Fig. 4. Water in the reservoir will be backed up 310 miles behind the dam, which will be about 90 miles into the Sudan.

The total estimated cost of the Sadd-el-Aali, excluding the power plant and the high-tension switching station, is in the order of 110 million Egyptian pounds (£ E.), or 315 million dollars. There will be an additional £ E. 10 million (28 million dollars) for indemnities. The grand total cost of the construction of the Sadd-el-Aali including power plant, transmission line to Cairo and the reclamation of 2 million acres is estimated at about £ E. 240 million (680 million dollars).

**Existing Aswan Dam, completed in 1902 and raised in 1907 and 1929, is 3.7 miles downstream from site of new dam.**



# Direct solution for apron elevation

**E. A. ELEVATORSKI, A.M. ASCE**

Assistant Professor of Civil Engineering, University of Arizona, Tucson

In designing hydraulic structures, engineers are frequently confronted with the problem of preventing erosion of the foundation below the spillway section. Various methods of energy dissipation have been used to achieve tranquil flow conditions as the flow enters the downstream channel. The primary purpose of all such methods is to convert as much as possible of the kinetic energy of the flowing water into turbulent energy and ultimately into heat. The required energy dissipation is frequently accomplished by the construction of a hydraulic jump-type stilling basin. However, to utilize the hydraulic jump it is necessary that the downstream depth of the jump be not greater than the tailwater depth or the jump will be swept downstream. Consequently, the elevation of the stilling basin apron must be accurately determined for all anticipated discharges.

The standard solution of the apron elevation has been a trial-and-error process requiring a considerable amount of time. It is possible, however, to relate the pertinent variables in dimensionless form and secure a direct solution.

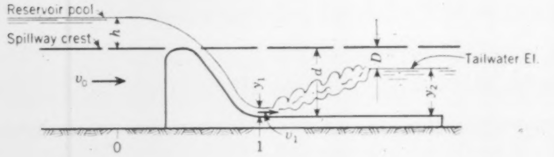


**FIG. 1. Variables involved in solution are illustrated on sketch of stilling basin of hydraulic-jump type.**

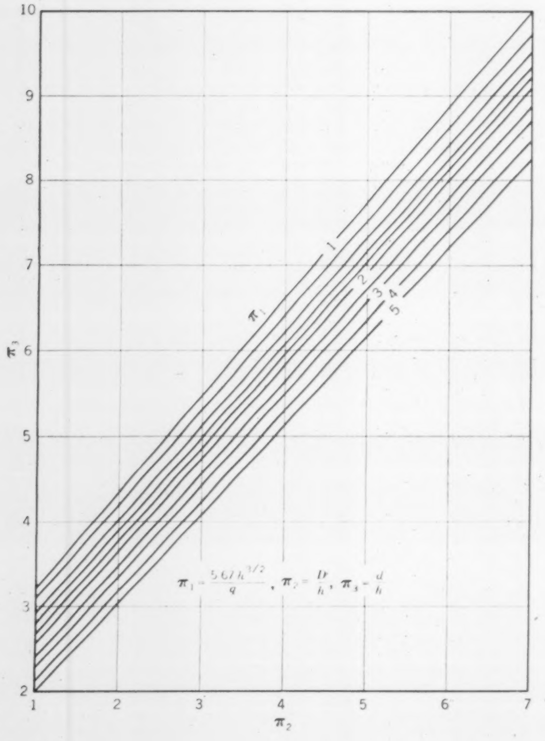


**FIG. 2. Graph for apron elevation gives value of $\pi_3$ when $\pi_1$ and $\pi_2$ have been computed.**

## Derivation

The variables involved in the solution are illustrated in Fig. 1. By writing the energy equations between sections 0 and 1, neglecting $v_0$, the velocity of approach, and the frictional loss between the sections, the velocity at the base of the spillway is

$$v_1 = \sqrt{2g(d+h)} \quad (1)$$

Since $y_1 = \frac{q}{v_1}$, where $q$ is the discharge per foot of spillway width (cu ft per sec per ft), Eq. 1 becomes

$$y_1 = \frac{q}{\sqrt{2g(d+h)}} \quad (2)$$

or

$$y_1 = \frac{q}{\sqrt{2}\, g^{1/2} \left(\frac{d}{h}+1\right)^{1/2} h^{1/2}} \quad (3)$$

The downstream depth, $y_2$, necessary for the hydraulic jump to form is given by Eq. 4.

$$\frac{y_2}{y_1} = \frac{1}{2}\left(\sqrt{1+\frac{8}{g}\frac{q^2}{y_1^3}} - 1\right) \quad (4)$$

Referring to Fig. 1,

$$\frac{y_2}{y_1} = \frac{d-D}{y_1} \quad (5)$$

Substituting Eqs. 3 and 5 in Eq. 4 we have

$$\frac{2d-2D}{y_1} + 1 = \sqrt{1 + \frac{16\sqrt{2}\, g^{1/2}\left(\frac{d}{h}+1\right)^{3/2} h^{3/2}}{q}} \quad (6)$$

or in dimensionless form,

$$\left(\frac{g^{1/2} h^{3/2}}{q}\right)\left(\frac{d}{h}+1\right)^{1/2}\left(\frac{d}{h}-\frac{D}{h}\right) + 0.353 = \left[0.125 + \frac{2.828\, g^{1/2} h^{3/2}\left(\frac{d}{h}+1\right)^{3/2}}{q}\right]^{1/2} \quad (7)$$

If we let

$$\pi_1 = \frac{g^{1/2}\,h^{3/2}}{q},\ \pi_2 = \frac{D}{h},\ \pi_3 = \frac{d}{h}$$

Then

$$\pi_1\,(\pi_3 + 1)^{1/2}\,(\pi_3 - \pi_2) + 0.353 =$$
$$[0.125 + 2.828\pi_1\ (\pi_3 + 1)^{3/2}]^{1/2} \qquad (8)$$

Values of $\pi_3$ for corresponding values of $\pi_1$ and $\pi_2$ have been computed from Eq. 8 and are plotted in Fig. 2. The range of the $\pi_1$ curves represents the values normally encountered by the designer. The curves use $g = 32.2$ ft per sec², and are applicable therefore only in the foot-pound-second system. Equation 7 is applicable for all systems provided consistent units are employed. The following example applies the solution to a specific problem.

### Illustrative problem

Find the apron elevation required for a hydraulic jump-type stilling basin below the spillway portion of a dam with the following items known:

| | |
|---|---|
| Unit discharge, | $q$ = 100 cfs per ft |
| Reservoir pool elevation | = 100 ft |
| Spillway crest elevation | = 90 ft |
| Tailwater elevation | = 31 ft |

Compute $\pi_1$ and $\pi_2$.

$$\pi_1 = \frac{5.67\,h^{3/2}}{q} = \frac{(5.67)\,(10)^{3/2}}{100} = 1.79$$

$$\pi_2 = \frac{D}{h} = \frac{90 - 31}{10} = 5.9$$

Entering Fig. 2 with the computed values, we find $\pi_3 = 8.0$.

Then $d = (8.0)\,(10) = 80$ ft

Therefore the required elevation of the stilling basin apron would be 10.0 ft.

### Energy losses

The energy loss on the spillway face has been neglected in the analysis. For high spillways, the influence of boundary resistance may be appreciable. However, by neglecting the loss due to friction, a slight excess of tailwater will be provided in the basin. The author has observed that a slightly drowned jump produces a better all-around energy dissipator as compared to one designed for the $y_2$ depth. A slight excess of tailwater also moves the toe of the jump against the sloping face of the spillway, stabilizing the jump, and producing a smoother over-all operation.

The assistance of Dr. R. C. Neff, who computed the values used to prepare the curves in Fig. 2, is gratefully acknowledged.

Full-size prints of Fig. 2 are available at cost (10 cents a sheet) from the Mailing and Mimeographing Department, University of Arizona, Tucson, Ariz.

# Moment distribution factors for tapered beams

**J. M. GERE, A.M. ASCE**

Associate Professor, Stanford University, Stanford, Calif.

In the analysis of continuous beams and rigid frames by the moment distribution method, it is necessary to have values of carry-over factors, stiffness factors and fixed-end moment coefficients. If the structure consists of tapered members of I-section, such as those shown in Fig. 1, the method is not practicable unless the various moment distribution factors are readily available, since to calculate them by ordinary means is a very tedious process.

For the tapered beam shown in Fig. 2, Fig. 3 gives values of the carry-over factor. Note that the beam may be either of I or box cross-section. The beam has a length $L$ and total depths $d_B$ and $d_A$ at the large and small ends respectively. The symbol $COF_{AB}$ is used to represent the carry-over factor from end $A$ to end $B$ of the beam, assuming end $B$ to be fixed. This factor is equal to ½ when the member is without taper, that is, $d_B/d_A = 1$. Similarly, the symbol $COF_{BA}$ denotes the carry-over from end $B$ to end $A$. The graph is drawn for two values of the quantity $n$, which is called the shape factor and is given by the formula,

$$n = \frac{\log I_B/I_A}{\log d_B/d_A} \qquad (1)$$

where $I_A$ and $I_B$ represent the moments of inertia at the ends of the member. For all practical shapes and tapers of beams, the value of the shape factor $n$ is between 2.1 and 2.6.

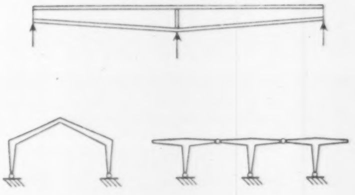


**FIG. 1. Typical structures with tapered members**

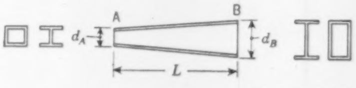


**FIG. 2. Tapered beam of I or box section**

Stiffness factors for the tapered beam of Fig. 2 are presented in Figs. 4 and 5. In Fig. 4, $K_{AB}$ represents the stiffness of the beam at end $A$ when end $B$ is fixed and is equal to 4 $EI/l$ when there is no taper. The stiffness $K_{BA}$ at end $B$ is given in Fig. 5. This stiffness is also equal to 4 $EI/l$ when the beam is prismatic.

Fixed-end moment coefficients for a beam with uniform load $w$ are given in Fig. 6. Note that when there is no taper, the value obtained from the graph is 0.0833, which corresponds to a fixed-end moment equal to $wl^2/12$. Fixed-end moments due to sidesway and settlement (see Fig. 7) can be computed from the formulas,

$$M_A = K_{AB}\,(1 + COF_{AB})\,(\Delta/l) \quad (2)$$

$$M_B = K_{BA}\,(1 + COF_{BA})\,(\Delta/l) \quad (3)$$

The procedure in using the graphs is to begin by calculating the shape factor $n$ from Eq. 1. With this factor known, values of carry-over factor, stiffness factor, and fixed-end moments can be determined from the graphs. These values can be interpolated between the curves plotted for $n = 2.1$ and $2.6$. Next, Eqs. 2 and 3 are used to find fixed-end moments due to sidesway and settlement, if needed. With all the above factors determined, the structure can be analyzed by straightforward application of the moment distribution method, which is presented in many textbooks and is familiar to most structural engineers.

A more complete discussion of the moment distribution method as applied to tapered I-beams is given in the writer's report, "Moment Distribution Factors for Beams of Tapered I-Section," available from the American Institute of Steel Construction, Inc., 101 Park Ave., New York 17, N. Y. In this report additional graphs are presented for carry-over factors, stiffness factors, and fixed-end moment coefficients.

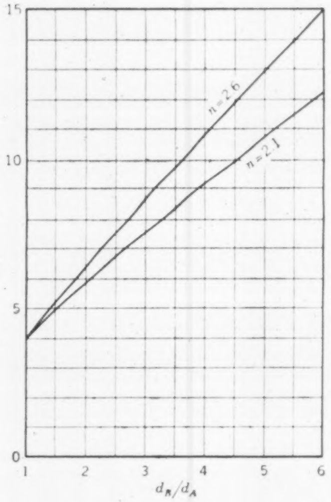


**FIG. 4. Graph for stiffness $K_{AB}$**

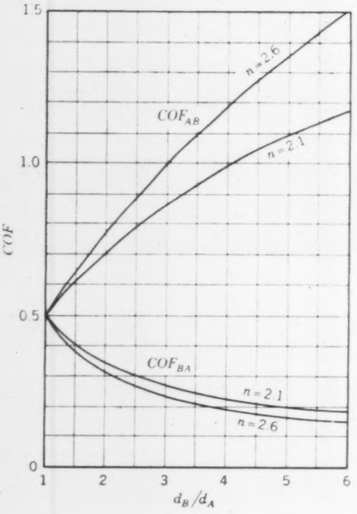


**FIG. 3. Graph for carry-over factors**

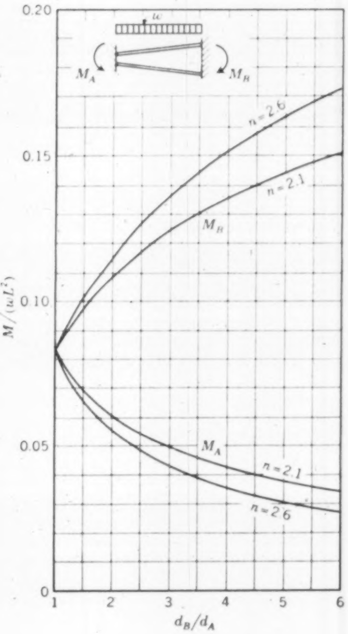


**FIG. 6. Graph for fixed-end moments due to uniform load**

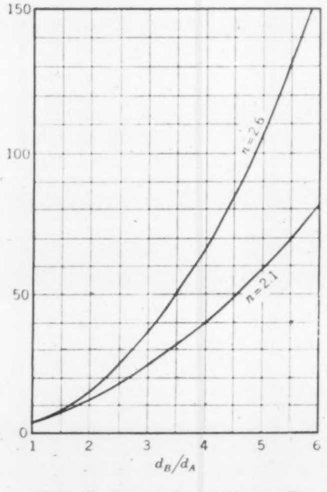


**FIG. 5. Graph for stiffness $K_{BA}$**

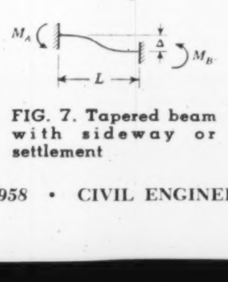


**FIG. 7. Tapered beam with sideway or settlement**

# SOCIETY NEWS

## Dams and Timber Highlighted in Portland Convention Program

Better utilization of timber, behavior of rockfill dams, water use in the Columbia Basin, and pipeline advances in the West dominated the technical discussions at the Society's Portland, (Ore.) Convention in late June. A record 130 papers were presented to good audiences at the 37 technical sessions. The Oregon Section members were exceptional hosts; they provided excellent entertainment and an unusual number of instructive inspection trips. Some 700 engineers attended the meeting; total registration, including the ladies, was about 950.

### Francis Friel Presidential Nominee

The Board of Direction of the Society met for two days under the chairmanship of President Louis R. Howson. One of its most important actions was the selection of Philadelphia consultant Francis Friel, now a Vice President of ASCE, as the nominee for next President. Other actions of the Board are reported elsewhere in this issue.

### Unity of the Profession

Of special interest to all engineers were proposals by Mason Lockwood, Past President of ASCE, for enlarging and strengthening Engineers Joint Council as a step toward effective unity in the profession. The major portion of Mr. Lockwood's talk appears on page 42 of this issue.

Another view of the controversial subject of unity was presented by Mr. Lockwood's fellow Texan, T. Carr Forrest, Jr., consulting engineer of Dallas, who stated that the engineering profession needs to become much stronger before it can become a successful unity organization. Mr. Forrest, a former president of the NSPE, said that the weakness of the profession is that too many engineers have neglected their obligation to become registered engineers. Mr. Forrest is inclined to leave engineering organizations as they are, each to proceed with its own activities. He recognizes that there will be duplication of effort, but believes that "Each and every one of them is doing some good, and if all could by common effort infuse each and every one of us, and those who follow with a feeling of individual responsibility, such time and effort will pay dividends. As each of these organizations and societies carry on their activities, time will prove their worth, and those who are worthy will survive, while those who prove unworthy will fall by the wayside."

Speaking on "Education as it Affects Unity in the Engineering Profession," Frederick C. Lindvall, chairman of the division of engineering at California Institute of Technology and president of the American Society for Engineering Education, said: "Unity to have meaning must have substance. More than an occasional rally to common action, an affirmation of faith as an engineer, a statement of principles of ethical practice and a loose confederation of our several professional societies is necessary to unity. Indeed, these factors would follow as consequences of true unity rather than as means for achieving it."

Professor Lindvall was critical of the Report of the ASCE Task Committee on Professional Education (Civil Engineering for February 1957, page 61), which recommended: "Although certain undergraduate courses are commonly required for all students in engineering, civil engineering curricula must maintain their separate identities and objectives, and the civil engineering departments of our colleges should receive support consistent with the civil engineer's great contribution to society."

**ASCE President Louis R. Howson congratulates Vice President Francis Friel, of Philadelphia, who is official nominee for 1959 President.**

Professor Lindvall concluded, "We college teachers badly need help from the professional societies if we are to convince our students that unity in the profession is possible and that it is wanted. We can do much in our engineering curricula to develop better attitudes toward unity without abandoning our engineering "options" by minimizing differences, developing similarities, common subject matter, common principles. . . . We must provide better engineering *education* and not specialized *training* if we

**President Howson talks over the Society's Los Angeles Convention, set for February 9-13, with Trent Dames (center), general chairman for that meeting, and Los Angeles Section President Walter H. Cates.**

**Highway Division panel on Spacing and Location of Interchanges on Freeways heard views of R. H. Kenyon of Washington; E. T. Telford of California; Jack Leish of Chicago; Max F. Wehrly of Washington, D. C.; W. S. Pollard of St. Louis; John T. Black of Chicago; and Wilson T. Ballard (right) of Baltimore, who presided.**

**J. C. Stevens Hall of Hydromechanics at the new Oregon Museum of Science and Industry was dedicated at a Hydraulics Division Dinner. Pictured in the nearly completed structure are Samuel B. Morris, Vice President of ASCE and principal speaker; the honoree, J. C. Stevens; and Ormond Bean, leading Portland citizen.**

**Walter Bushnell (left), chairman of the Oregon Section Public Relations Committee, greets President and Mrs. Howson at the Portland Airport. At right is "Queen Ruth I of Rosaria," Queen of the Portland Rose Festival.**

are to achieve professional stature and with it professional unity."

"High grade college faculties, like mellow whiskies, cannot be created over night," said J. E. McKee, professor of sanitary engineering at California Institute of Technology, Pasadena. He blamed an attitude of self-pity and public lamentation among college professors for scaring away the best of a potential crop of young men for teaching. He demonstrated that teaching income is average for the profession, but he is most anxious to make it much higher to assure that the best talent will be attracted to this training of tomorrow's engineers.

Governor Robert D. Holmes of Oregon, in a welcoming talk, stressed the need for a broad liberal background for engineers to enable them to take their rightful place in public leadership. There is work and opportunity for engineers in Oregon with its great water and timber resources.

ASCE President Howson, in his Presidential address to the Society, deplored the fear complex that has developed from recent technological advances, and said that as scientific discoveries have occurred, material things always have been made to serve higher ends. He also asked engineers to take a more active part in civic affairs, pointing out that only 10 percent of ASCE members participate actively and less than half in any way.

Excerpts from Mr. Howson's address, "Good Engineering Adequately Communicated," appeared in the July issue of Civil Engineering (page 33).

### Sessions on Timber

Current use and future possibilities of timber constituted a principal theme of the Structural Division sessions. The Northwest is anxious to have engineers everywhere know more about new materials and improved utilization of wood products as an aid to the economy of the timber country. Use of glued laminated construction has increased 500 percent in the past three years, but Europe is far ahead of the U. S. in use of long-span wood.

Of special interest is a new delta truss, developed by Moffatt, Nichol & Taylor and reported by Guy H. Taylor. This truss is planned for a 14,000-seat Arena Building that is part of an Exposition-Recreation Center to be built in Portland. The Arena Building will be 360 ft square with four piers, each 45 ft in from the exterior walls, supporting the roof framing 85 ft above the arena floor. Thus the span of two-jack trusses and the twelve delta timbers girders is 270 ft with a 45-ft cantilever at each end. The delta roof systems resulted from a study of acoustics, fire protection, and roof framing systems of structural timbers and realization that the timber needed might all be utilized to form timber plates of a delta system. The 30-ft-wide delta girders are made up of 1-in. web boards in two layers opposing each other at 45 deg with glued laminated timber flanges. Scale models of ${}^1/_{16}$ and later ${}^1/_5$ size have proved the feasibility of the structure and show that computed deflections closely approximate those found under test.

White gloves are a necessity for handling finished timbers, even heavy ones, Elon Ellis, of Timber Structures, told a Construction Division Session. The improved appearance of timber framing has encouraged use in fine finished buildings such as churches, schools, and offices. But the fine finish must be maintained by use of soft slings, clean gloves for handling, and paper to walk on. Otherwise, clean-up cost is exorbitant.

Timber is a living, renewable crop, not a dead, diminishing resource. Government statistics show that we are growing 25 percent more than we are cutting. And as to quality, timbers of glued laminated lumber can be made up into larger and better material than could ever be sawed directly from trees, according to Frank J. Hannahan of the American Institute of Timber Construction. Practically, the size and span of glued laminated members are limited only by transportation, the longest to date being 300 ft. However, longer ones are already planned for use in Portland.

Shrinkage in glue-laminated members is being alleviated by gluing up and maintaining the lumber at near the moisture content expected in permanent service. Experience has shown that long-time deflection is likely to exceed greatly the initial deflection and should be provided for.

## Rockfill Dams Discussed

The construction, behavior and maintenance of rockfill dams throughout the world were covered in five joint sessions of the Power, Construction, and Soil Mechanics and Foundations Divisions. Troubles encountered on some 25 dams were told to provide designers and maintenance men with information for better construction. The largest single problem is percolation, mainly caused by settlement. Some of the largest dams have had very little movement. Others have had little leakage or need for maintenance despite a few feet of settlement, which usually is in a plane normal to the face.

Three major types of rockfill dams were discussed: impervious sloping core, vertical core common for higher structures, and concrete faced. The latter type normally is used where impervious fill is not economically available. W. G. Huber, Vancouver, B. C., consultant, comments that impervious core dams are earthquake and bomb resistant as they are

**Important concrete-faced, rockfill dams were discussed by Dev N. Porto (left), of Hydro Electrica de Cavado Portugal; J. B. Cooke, of Pacific Gas and Electric Co.; J. F. Bonner, of Power Division's Executive Committee, who presided; and I. C. Steele, San Francisco consultant.**

**Franklin Sunn (left), president of Hawaii Section, and Mr. and Mrs. Arthur Akinaka came to Portland to present warm invitation to Post-Convention meeting in Hawaii. With them is Ray Schwengler, of Portland.**

**Speakers at final session on rockfill dams were (left to right) John B. Snethlage of New York City; Robert A. Monroe, chief design engineer of TVA, who presided; R. J. Pope, of Corps of Engineers, Portland; and George K. Leonard, chief engineer of TVA.**

**ASCE Committee on Convention Policy and Practice met in Portland. Left to right are Don Reynolds; Executive Secretary W. H. Wisely, Director W. J. Hedley, Past President D. V. Terrell, Glenn Holcomb, E. S. Kirkpatrick, and Presidential Nominee Francis S. Friel.**

**Swift Dam was the subject of three papers and an interesting field trip sponsored by Soils Mechanics and Foundations Division. Speakers and hosts were (left to right) James G. Patrick and Harris H. Burke, both of Bechtel Corp.; E. R. de Luccia, Pacific Power & Light; and Ralph Fadum presided.**

self healing under shock. Swift Dam on the Lewis River in southwestern Washington has a vertical core curved upstream so that any movement tends to consolidate rather than open up the structure.

Dams described ranged from several just being completed to some that have been in service for many years. In the former group are 400-ft-high Brownlee on the Snake River in Idaho where placing 7.5 million cu yd of material is just being completed. Paradela Dam, a 380-ft-high concrete-faced structure just completed in Portugal, was described by N. Porto of Hydro Electrica de Cavado.

Difficulties and high maintenance costs at Dix Dam in central Kentucky were discussed by Lewis A. Schmidt, Jr., of Chattanooga, who worked on its construction and has since been consultant on maintenance. When built (1923-1925) its 275-ft height was the record for a rockfill dam. But leakage has been such a serious problem during its entire life that Mr. Schmidt questions the desirability of constructing a faced rockfill dam in a limestone region where conditions are such that the reservoir cannot be drawn for periodic examination and repair of the face. Despite considerable cost and inconvenience to water users, this will have to be done some time soon at Dix.

## Water a Major Topic

Water—its conservation, use, and control—was the subject of numerous papers originating in the West. The Columbia is big, but not big enough to take all the refuse people would like to dump into it. At Portland a number of organizations are much concerned with cleaning up the Willamette as the fast-growing population and added industry nullify progress made. All the agencies are much concerned with maintaining the water in a condition that encourages recreation, one of the Northwest's great attractions. California has had considerable success in replenishing underground water for dry-season use by ponding imported Colorado River water over pervious ground in winter.

Snow studies and stream-flow regulation by computer aid control of Columbia River water. But the Columbia, which now has 10,000,000 acre-ft of storage, needs an additional 8,000,000 acre-ft to be really effective. Even the present storage has a value estimated at $5,000,000 annually by Brig. Gen. Louis H. Foote, retired Army officer, now a consulting engineer in Oregon.

Railroads have thousands of miles of right of way along routes that pipelines logically should follow and are getting into the pipeline business. This was brought out by E. H. Schmitt of Tulsa at interesting pipeline sessions. Railroads have been slow to enter this field but now are trying to utilize their rights of way and other facilities in transportation. Through smaller towns the pipeline can parallel the track, but in towns of greater than 20,000 population it usually is cheaper to go around to avoid utilities.

Uniform surveying and mapping programs so that there will be "certainty in the ownership of land" was proposed by Burton R. Ingalls, Engineer in Charge of the Washington State Bureau of Surveys and Maps. The general confusion that besets the whole field of surveying and mapping is partially due to the large number of organizations engaged in performing surveys and making maps. Another problem is the varying language used in the surveying systems.

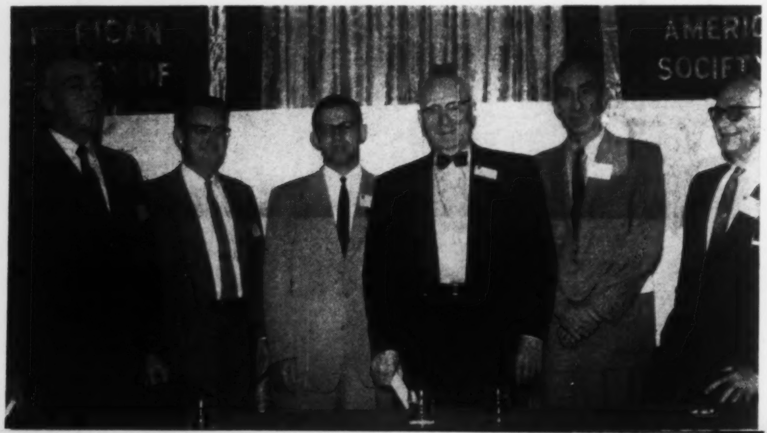
In the State of Washington there are 52 federal and 26 state, 80 county, 120 city, 49 power and 50 miscellaneous private agencies, plus 32 map companies and 20 aerial photographic agencies all producing maps of Washington areas. Each of these keeps files, a prodigious waste of recording, duplicating and filing effort. Only the state government can provide the service of a central information and coordinating agency. The State of Washington has done so with the creation of the Bureau of Surveys and Maps.

## Credit Where It Is Due

Portland was well aware of the ASCE Convention through the effective public relations activities of Walter Bushnell at Portland and Mike Chenoweth of Society Headquarters. Attendance at the technical sessions was high due to promotion headed by William D. Hege and excellent programs arranged under the leadership of Norbert Leupold. Excursions to dams in the area, the lumber industry, highway and pipeline construction were handled by Kenneth Anderson and D. K. Ford. Entertainment, and it was the best, was the responsibility of Guy H. Taylor. Mrs. H. Loren Thompson and Mrs. Walter Bushnell headed the Ladies' Committee.

Top convention planning was most capably done by H. Loren Thompson, chairman, with F. Stewart Brown, vice chairman, and Charles F. Craig, president of the Oregon Section. But those named are only a few of the very large number who gave their time and best hospitality to make the Portland Convention enjoyable as well as professionally rewarding.

**Morrison Street Bridge in Portland and highways in general were discussed at Structural and Highway Divisions joint session by Raymond D. Bane, of Sverdrup & Parcel; J. L. Beaton, senior highway engineer, California Highway Department; R. M. Bonney of Portland; John I. Parcel of St. Louis; F. B. Crandall, of Oregon Highway Department; and Elmer Timby of New York City.**



# What the Board Did in Portland

A number of important actions were taken by the Board of Direction of ASCE during its Portland meeting. Significant recommendations were aimed at increasing unity among engineering organizations; increasing public awareness of the work and capabilities of engineers; and bringing reclassification of members before the October Convention. Other important actions included the nomination of ASCE Vice President Francis S. Friel, of Philadelphia, as President for 1959; the naming of three new Honorary Members; authorization of new Local Sections in South Dakota and Central Pennsylvania and a Student Chapter at Stevens Institute in Hoboken, N. J.; and restriction of the formation of foreign Sections of the Society.

## Unity of the Profession

The Board voted in favor of the earliest feasible amalgamation of Engineers Council for Professional Development with Engineers Joint Council, and to approve acceptance of the Charter of Incorporation of EJC in the state of New York. The ASCE Board approved admission of the American Institute of Plant Engineers to EJC.

## Civil Engineering Achievement

The Board endorsed a program for annual recognition of the "Outstanding Civil Engineering Achievement of the Year" and directed the Executive Secretary to develop a specific plan for carrying it out. The award would go to the one U. S. engineering project completed during the year that demonstrates the greatest engineering skill and represents the greatest contribution to engineering progress and to the welfare of mankind. The project, selected by a group of editors of civil engineering journals from nominations from each district, would be approved by the Board of Direction. The award will honor the structure and all who contributed to its development rather than any individual engineer involved.

## Classification of Members

With a change in name of the top grade of membership to "Fellow" and minor rewording, the proposal of the Task Committee on Classification of Members (July 1957 issue, page 81) was accepted. It is planned to present the proposal to the membership meeting at the October Convention and then to letter ballot of the membership in the form of an amendment to the Constitution. The new designations would be: Associate (replacing Junior Member); Member (approximating the present Associate Member grade); and Fellow, which requires professional registration and other upgrading, except that all current Members would automatically move to that grade.

## Manuals of Engineering Practice

Publication of the following Manuals of Engineering Practice was authorized:

1. Manual for Design and Construction of Sanitary and Storm Sewers
2. Manual of Practice on Sewage Treatment Plant Design

(These are to be produced jointly with the Federation of Sewage and Industrial Waste Associations. The cost to ASCE will be $5,500 for each.)

3. Manual on Ground Water ($4,000)
4. Manual on Sanitary Landfill ($1,500)

The Manuals are expected to be self-liquidating.

Publication of a cumulative Index of Transactions for the years 1947-1958, was authorized at an estimated cost of $16,000. This will be ready late in 1959.

## No More Sections Outside U. S.

Members in foreign countries will be especially interested in a Board resolution that no new Local Sections or Student Chapters are to be formed outside the U.S. and its possessions. The present Sections and Chapters will be maintained. Groups in other countries may organize without formal authorization an Overseas Unit for promoting technical and professional contacts. Society headquarters will cooperate by supplying lists of members, by asking the national engineering society of the country for its friendly cooperation, and by carrying notices of meetings in CIVIL ENGINEERING. Such Overseas Units must be self supporting and are not to act for ASCE except as specifically authorized.

## Technical Division Recommendations

Merger of the U.S. National Council on Soil Mechanics and Foundation Engineering with the ASCE Soil Mechanics and Foundations Division was approved. About 50 members of the Council, not now members of ASCE, will be especially encouraged to become Members or Affiliates of ASCE. The Soil Mechanics and Foundations Division will continue contact with the International Society of Soil Mechanics and Foundation Engineering. Moneys of the Council (some $3,000) will be turned over to ASCE, which will assist in sponsoring International Soil Mechanics Conferences.

The Board approved participation of the Structural, City Planning, and Construction Divisions in the Fourth National Construction Industry Conference, to be held in Chicago in December 1958.

## Other Board Actions

The Board considered 115 unusual membership qualification cases referred by the Membership Qualifications Committee; several applications were declined. Formal action was also taken on eight Professional Conduct cases, mostly concerned with price bidding for engineering work. There have been several incidents during the year where reminders of the ASCE position on price bidding for engineering work have been helpful.

In an important political action the Board recommended that geometric standards for the Interstate Highway System be resolved by technical conferences between the Bureau of Public Roads and the various state highway departments. This recommendation was brought about as a result of U. S. Congressional Committee discussion regarding maximum standards of geometric design.

Closer home, the Board advised its representatives on United Engineering Trustees that no commitments should be made for construction of the United Engineering Center until funds are at hand or satisfactory interim financing is arranged. The Board also advocates "conventional bidding procedures" for selection of contractors for the Engineering Center.

ASCE will ask the American Standards Association for a periodic check on the progress of sectional committees in which civil engineers are interested. Some committees have not taken any action in years. It is hoped that the Board's stand will result in closing out unnecessary groups, and will stimulate others to become active.

It was reported to the Board that an Engineers Joint Council-American Institute of Architects Joint Committee has been organized, and that it will assume handling of the Engineer-Architect Agreement forms. The ASCE-AIA Joint Cooperative Committee has been discharged. The ASCE-AWWA Committee on Spillways has also been dissolved.

*(Board actions continued)*

### Committee Appointments

To create a standing *Committee on Society Fellowships, Scholarships, Grants, and Bequests*, the following were appointed, effective October 1, with terms running to October of the year indicated: John K. Vennard, chairman (1959); Lorenz G. Straub (1960); Martin A. Mason (1961); George H. Hickox (1962); and Samuel B. Morris (1963).

Other appointments made or confirmed by the Board include:

*Engineering Societies Library Board:* Harold M. Lewis to succeed himself for a four-year term.

*United Engineering Trustees:* Charles B. Molineaux to succeed himself for a four-year term.

*John Fritz Medal Board of Award:* Louis R. Howson to succeed Daniel V. Terrell for a four-year term. Howard T. Critchlow continues to serve as alternate.

*Engineers Council for Professional Development:* Dean William P. Kimball to succeed Dean Harold E. Wessman for a three-year term.

*UPADI* (Pan American Federation of Engineering Societies): Gail Hathaway as ASCE member of EJC delegation to UPADI Conference in Montreal, September 2-6.

*Engineering Societies Library Study Committee:* Walter E. Jessup and Harold M. Lewis as ASCE representatives.

*American Sanitary Engineering Intersociety Board:* Blucher A. Poole to succeed William A. Hardenbergh for a three-year term.

*Conditions of Practice Committee on Publications:* Frank A. Marston, chairman (October 1959); Trent R. Dames, vice-chairman (1960); Sidney Robin (1961); and Joseph B. Brooks (1962).

### Research Prize Awards

The Board approved the recommendations of the Commission on Division Activities for award of the 1958 Research Prizes to the following: Dr. John W. Clark, Dr. Hans A. Einstein, Dr. Warren J. Kaufman, and Dr. Ivan Viest. Presentation of the awards to them will take place in February.

### Board and Staff Travel

Visits of ASCE Officers and headquarters staff made this year to Regional Conferences, Local Sections, and committee meetings were announced. Members of the Board made 136 visits and members of the staff 214 visits.

### ASCE Conventions Scheduled

| | | |
|---|---|---|
| **1958** | Oct. 13-17 | New York, N. Y. |
| **1959** | Feb. 8-13 | Los Angeles, Calif. |
| | May 4-8 | Cleveland, Ohio |
| | Oct. 19-20 | Washington, D. C. |
| **1960** | March 7-11 | New Orleans, La. |
| | June 19-25 | Reno, Nev. |
| | Oct. 9-13 | Boston, Mass. |
| **1961** | April 10-15 | Phoenix, Ariz. |
| | Oct. 16-20 | New York, N. Y. |
| **1962** | Feb. 19-23 | Houston, Tex. |
| | May | Omaha, Nebr. |
| | Oct. 8-12 | Detroit, Mich. |

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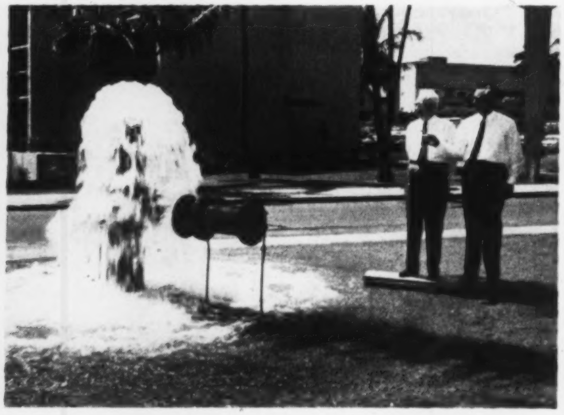
## Hawaii Section Provides Royal Entertainment For Mainland Visitors

From the realm of roses to the land of leis, a group of Society members—including President Howson, Vice President Morris, and Secretary Wisely—made the trip from Portland to Honolulu for the Hawaii Section's Post-Convention meeting. Continuing the fine hospitality and organization that marked the Portland Convention, Hawaii Section members planned a full and interesting schedule for the visitors. Upon their arrival in Hawaii, members were taken on an automobile tour of the capital city.

On July 1, the meeting was formally opened when Section president Franklin Sunn welcomed the members from the mainland. In a general session, before the specialists withdrew to their respective meetings, William M. Wachter, Superintendent of Public Works for the Territory of Hawaii, spoke on "The Territorial Transportation Problem." Groups held simultaneous technical sessions. The Territory's "Unique Water System" was discussed by a panel of experts, consisting of: Robert T. Chuck, chief of design and construction for the Hawaii Water Authority; Arthur R. Tyler, engineer and superintendent of the Suburban

**Studying Hawaii's water system (photo at left), Secretary Wisely, President Howson, and Vice President Morris join other visitors on tour of Halawa Water Tunnel pumping station. In right hand view, E. F. Morgan, manager and chief engineer of Board of Water Supply, discusses with President Howson one of nine flowing wells which form a major part of Honolulu's water supply. Adequate water supply is an increasingly serious problem in Hawaii.**



Delegation of mainland members arrive in the land of leis for the Post-Convention Meeting in Honolulu and are greeted by President Franklin Sunn, of Hawaii Section. From the top of ramp visitors are: Mr. and Mrs. H. P. Kay of Texas; G. P. Boomsliter, Georgia; Mrs. Louis Howson; Mrs. Harold Blakeslee, Connecticut; Mr. and Mrs. Lloyd Knapp, Wisconsin; Mr. Blakeslee; President Sunn; Mrs. Shedd (mother of Mrs. Richard Holmgren), Mrs. Holmgren, Washington; Mr. Holmgren; Miss Sandra Holmgren; Mrs. Charles Park, Washington, D. C.; Mr. Howson; Admiral Park; and Executive Secretary and Mrs. William H. Wisely.

Water System; Frank Visher, project chief, Pearl Harbor Investigation, U.S. Geological Survey; and Henry A. Wicks, assistant manager of the Board of Water Supply. The Structures Group heard Don L. Richter, design engineer of product development with Kaiser Aluminum & Chemical Sales, Inc., discuss "Recent and Future Developments in the Kaiser Aluminum Dome."

In the afternoon, the ladies joined their husbands for a field trip to the Halawa Water Tunnel. This tunnel features a unique inclined shaft to the pump room which is situated at ground water level. A 900-ft horizontal shaft below the water table is capable of delivering 20 mgd. In native costume, the mainland engineers learned more of the Hawaiian way of life at a buffet dinner which featured traditional Hawaiian entertainment. The high point of the evening's festivities was the hula lesson for members.

## Serious Soil Problems

At the general session on July 2, Ralph B. Peck, professor of foundation engineering at the University of Illinois, discussed the "Soft Ground Portion of the Wilson Tunnel, Honolulu." At this tunnel in 1954, the soft ground section caved in killing five workmen. Later in the day, members toured the tunnel.

Again Technical Groups held simultaneous technical sessions. The Soils Panel discussed "Soil Problems of Hawaii." The panel was made up of Prof. John R. Evans of the University of Hawaii; Herbert Tateishi, principal materials engineer with the Territorial Department of Public Works; Wayne Duncan, soils and foundations engineer with the Corps of Engineers; and John Havers, chief engineer, Harland Bartholomew and Associates. Paul Liu served as chairman. In a session on computers, Reece S. Cave, Jr., IBM Time Equipment Division Manager, spoke on the vital subject, "Computers and Their Applications in Civil Engineering."

At the close of their stay, members were entertained in the Hawaiian Longhouse at the Hawaiian Village Hotel, convention headquarters. Francis Wai, past Section president, took some of the members for rides in outrigger canoes. The happy combination of a visit to beautiful Hawaii and instructive technical sessions was brought about by Arthur Chiu, convention chairman, and his hard-working committees.

## ASCE Prizes and Awards Are Announced by Board

On recommendation of the Committee on Society Prizes, the Board at its Portland meeting approved the following awards for papers published in Volume 122 (1957) of Transactions and in Civil Engineering. The prizes will be presented during the Society's Annual Convention, to be held in New York City this October. Brief biographies and photos of the winners are scheduled for the October issue.

### Norman Medal

Anestis S. Veletsos, J.M. ASCE, and Nathan M. Newmark, M. ASCE, for Paper, "Natural Frequencies of Continuous Flexural Members."

### J. James R. Croes Medal

William J. Oswald, A.M. ASCE, and Harold B. Gotaas, M.ASCE, for Paper, "Photosynthesis in Sewage Treatment."

### Thomas Fitch Rowland Prize

Charles I. Mansur, M. ASCE, and Robert I. Kaufman, J.M. ASCE, for Paper, "Underseepage, Mississippi River Levees, St. Louis District."

### James Laurie Prize

Chesley J. Posey, M. ASCE, for Paper, "Flood-erosion Protection for Highway Fills."

### Arthur M. Wellington Prize

Hamilton Gray, M. ASCE, for Paper, "Field Vane Shear Tests of Sensitive Cohesive Soils."

### Collingwood Prize for Junior Members

Turgut Sarpkaya, A.M. ASCE, for Paper, "Oscillatory Gravity Waves in Flowing Water."

On recommendation of the other Prize Committees, the Board also approved the following awards:

### Ernest E. Howard Award

Nathan M. Newmark, M. ASCE, for his contributions in the field of structural analysis and design as well as his specific contribution to the advancement of structural engineering in the aseismic design of the Latino Americana Tower in Mexico City.

### Rudolph Hering Medal

William J. Oswald, A.M. ASCE, and Harold B. Gotaas, M. ASCE, for Paper, "Photosynthesis in Sewage Treatment."

### Thomas A. Middlebrooks Award

H. Bolton Seed and Lyman C. Reese,

Associate Members ASCE, for Paper, "The Action of Soft Clay Along Friction Piles."

**Moisseiff Award**

Walter J. Austin, A.M. ASCE, Shahen Yegian, and Tie P. Tung, for Paper, "Lateral Buckling of Elastically End-Restrained I-Beams."

**J. Waldo Smith Hydraulic Fellowship**

William J. Troutman and The Massachusetts Institute of Technology. Mr. Troutman will investigate the effect of particle size and concentration on turbulence in circular pipes.

**Rickey Medal**

William F. Uhl, M. ASCE, for contributing "in an important manner to the science or progress of hydroelectric engineering."

**J. C. Stevens Award**

Frederick L. Hotes, A.M. ASCE, for his discussion of the Paper, "Ground-Water Development—Basin Recharge."

**Construction Engineering Prize**

Myers Van Buren, M. ASCE, for his article in the February 1957 issue of Civil Engineering, "Concrete Bridge Across Lake Pontchartrain Completed in Record Time."

## Tellers Canvass Ballot for 1959 Officers

*New York, N. Y.*
*July 1, 1958*

*To the Secretary*
*American Society of Civil Engineers:*

The Tellers appointed to count the Ballot for Official Nominees report as follows:

*For Vice-President—Zone II*

(Term October 1958—October 1960)

| | |
|---|---|
| Paul L. Holland | 1,931 |
| Scattering | 157 |
| *Ineligible Candidate | 106 |
| Void | 1 |
| Blank | 4 |
| Total | 2,199 |

*For Vice-President—Zone III*

(Term October 1958—October 1960)

| | |
|---|---|
| Lloyd D. Knapp | 1,127 |
| Ernest W. Carlton | 370 |
| Scattering | 366 |
| *Ineligible Candidate | 175 |
| Void | 0 |
| Blank | 36 |
| Total | 2,074 |

*For Director—District 1*

(Term October 1958—October 1961)

| | |
|---|---|
| Elmer K. Timby | 159 |
| Thomas J. Fratar | 27 |
| Scattering | 165 |
| *Ineligible Candidate | 96 |
| Void | 3 |
| Blank | 12 |
| Total | 462 |

*For Director—District 3*

(Term October 1958—October 1961)

| | |
|---|---|
| Earl F. O'Brien | 97 |
| Scattering | 23 |
| *Ineligible Candidate | 39 |
| Void | 0 |
| Blank | 4 |
| Total | 163 |

*For Director—District 5*

(Term October 1958—October 1961)

| | |
|---|---|
| Daniel B. Ventres | 108 |
| Waldo E. Smith | 42 |
| Scattering | 69 |
| *Ineligible Candidate | 32 |
| Void | 0 |
| Blank | 18 |
| Total | 269 |

*For Director—District 7*

(Term October 1958—October 1961)

| | |
|---|---|
| Charles W. Britzius | 284 |
| Scattering | 63 |
| *Ineligible Candidate | 38 |
| Void | 0 |
| Blank | 30 |
| Total | 415 |

*For Director—District 11*

(Term October 1958—October 1961)

| | |
|---|---|
| Wayne G. O'Harra | 564 |
| Scattering | 119 |
| *Ineligible Candidate | 208 |
| Void | 4 |
| Blank | 9 |
| Total | 904 |

*For Director—District 12*

(Term October 1958—October 1961)

| | |
|---|---|
| Fred H. Rhodes, Jr. | 537 |
| Scattering | 34 |
| *Ineligible Candidate | 53 |
| Void | 0 |
| Blank | 4 |
| Total | 628 |

*For Director—District 16*

(Term October 1958—October 1961)

| | |
|---|---|
| N. T. Veatch | 432 |
| Herbert E. Prater | 48 |
| Scattering | 36 |
| *Ineligible Candidate | 25 |
| Void | 2 |
| Blank | 5 |
| Total | 548 |

| | |
|---|---|
| Total number of ballots counted | 7,662 |
| Ballot envelopes without signature | 16 |

*Respectfully submitted,*
Robert W. Richards
*Chairman*
Robert C. Johnson
*Vice-Chairman*

Neal H. Bettigole
John H. Fisk
Lawrence Friedland
Thomas K. A. Hendrick
Stanley J. Johnson
Jack Kinstlinger
Louis J. Schmitt
Louis A. Volse
*Tellers*

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*These votes were cast for incumbent officers who are presently ineligible for reelection in accordance with Section 9, Article VI, of the Constitution.

## ASCE Names Three New Honorary Members

Three distinguished members of ASCE were elected to honorary membership in the Society during the Portland meeting of the Board of Direction. They were **Henry J. Brunnier,** consulting structural engineer of San Francisco, Calif.; **Nathan W. Dougherty,** dean emeritus of the College of Engineering, University of Tennessee, Knoxville; and **A M Rawn,** chief engineer and general manager of the Los Angeles County Sanitary District.

Presentation of their honorary memberships will be a feature of the Annual Convention in October. Biographies and photos of the new Honorary Members will be published in the October issue.

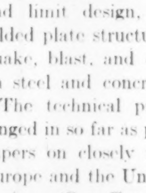
Honorary membership is regarded as the highest honor the Society can bestow. Only one out of every 7,500 members may be cited for the honor.

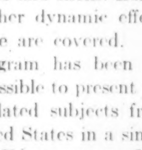
# Ambitious ASCE–IABSE Program at New York Convention

Practically the entire range of structural engineering developments throughout two continents will be discussed at the ASCE Convention in New York this October in a joint meeting of the ASCE Structural Division and the International Association for Bridge and Structural Engineering. Advances in structural design, research in the behavior of structures and properties of materials, and construction techniques will be covered in eight half-day sessions. Thirteen European engineers, from eight countries, and fourteen Americans will be on the program. The Engineering Mechanics and Construction Division will participate.

The program will give a well-rounded picture of recent advances and probable future trends in structural engineering, in addition to presenting the most advanced research and practice. Special attention is given in the program to current trends in design of both steel and concrete structures. The plastic method of design of steel structures will be discussed in several papers, and reports on investigations of the effect of ductility, creep and fatigue will be given. In concrete, emphasis is on ultimate strength and limit design, prestressed concrete, folded plate structures and shells. Earthquake, blast, and other dynamic effects on steel and concrete are covered.

The technical program has been arranged in so far as possible to present the papers on closely related subjects from Europe and the United States in a single session. (See CIVIL ENGINEERING, July 1958, p. 75.) In this way those who can attend only part of the sessions can select those of greater interest. All speakers participating in the program are leaders in the profession of civil engineering in their respective countries. They are distinguished for their accomplishments and writing in the particular areas of the subjects each will present. Biographical sketches of the European speakers are given here, with brief comment on their subjects.


S. O. Asplund


A. L. Baker

J. F. Baker

N. Esquillan

**S. O. Asplund,** professor of structural mechanics at Chalmers University, Gothenburg, Sweden, graduated with the degree of Civil Engineer in 1924 from the Royal Institute of Technology, Stockholm, and received the Doctor of Technology degree in 1943 from the same school. He worked in the United States from 1925 to 1929, mainly for the American Bridge Company, and as a contractor in Sweden since 1929. Since 1949 he has been on the faculty at Chalmers University as professor of bridge engineering until 1954, and of structural mechanics since 1955.

Professor Asplund's paper, "The Design, Construction and Performance of Short Flexible Suspension Bridges for Heavy Trucks," concerns temporary bridges of about 300-ft span for 40-ton construction trucks. These bridges can be built as flexible suspension structures with four or six wide-flange beams acting as longitudinal girders between crossbeams and, at the same time, as stiffening girders. A new notion of Green's matrix is summarized. Design details of shoes, expansion joints, hanger connections, and saddles that are influenced by large movements of the suspended span are described. Their performance under heavy traffic and the way in which discovered weaknesses were corrected are reported.

**A. L. L. Baker,** professor of concrete technology at the Imperial College of Science and Technology, University of London, holds the degree of Doctor of Science in Engineering. From 1926 to 1945, he held various engineering positions in England, Nigeria, and the Union of South Africa, and participated in design and construction of a variety of projects, including tunnels, marine structures, underground oil storage, and precast concrete multi-story buildings. He has been a professor at the University of London since 1945 and has published three books: "Reinforced Concrete," 1949; "The Ultimate Load Theory Applied to the Design of Reinforced and Prestressed Concrete Frames," 1956; and "Raft Foundations: The Soil-Line Method of Design," third edition, 1957.

Professor Baker's paper, "Ultimate and Other Design Criteria for Reinforced and Prestressed Concrete Frames," deals with: (1) an idealized conception of elastic members joined by plastic hinges; (2) basic parameters, minimum values, and theoretical assumptions for strength and deformation calculations of members and hinges; (3) a concept of safety factors and suggested values of such factors; and (4) the behavior of ultimate designs under working loads.

**J. F. Baker** is professor of mechanical sciences and head of the Department of Engineering, Cambridge University, England. Following graduation there in 1923, he worked on design of rigid airships until 1928, when he became technical officer to the Steel Structures Research Committee and responsible for organizing and carrying out much of the research that led to the Committee's recommendations for the design of steel structures published in 1936. He became professor of civil engineering at the University of Bristol in 1933. During the war, he headed the Design and Development Section of the Ministry of Home Security. He has been on the faculty of Cambridge University since 1943. Professor Baker recently published "The Steel Skeleton," which describes a rational and economical plastic method of designing steel structures, the subject of his current paper. In it he discusses the development of the plastic method of design in England from early tests on miniature portals through the consideration of collapse mechanisms to the examination of the behavior of continuous frames.

**Nicolas Esquillan,** technical director, Boussiron Enterprises (public works), Paris, has been with that group since 1923, beginning as an apprentice of Simon Boussiron, who pioneered in reinforced concrete as early as 1900. He has done or directed research on many notable reinforced and prestressed concrete structures. Among these are: a 538-ft span arch highway bridge; a 364-ft span bow-string bridge with triangular web system; a 407-ft span railroad bridge; a hangar at the Marignane airport roofed with two 333-ft-span shell vaults, each weighing 4,200 tons, which were cast on the ground and lifted into place; the first large prestressed railroad bridge in France; 410-ft-high pylons for the Tancarville suspension bridge; and the Exposition Palace, now under construction in Paris.

Mr. Esquillan presents the "Conception and Execution of the Shell Vault of the Palace of Expositions of the National Center of Industries and Techniques, Paris." Design and construction considerations of this largest-span concrete shell roof in the world are described. The roof, in the form of an equilateral triangle, will have an arch span of 781 ft and a surface area of about 226,000 sq ft, supported at three points.

**Yves Guyon,** technical director of the Technical Society for the Utilization of Prestress (S.T.U.P.), Paris, graduated from the Polytechnic School, Paris, in 1918. He began his professional career with Renault in 1922. From 1928 to 1935, he was chief engineer for the French branch of Blaw-Knox, and designed formwork for bridges, dams, tunnels and other structures. From 1935 to 1937, he was consulting engineer for the Society for Large Reinforced Concrete Structures. As a consulting engineer for various organizations since 1937 and in his present position since 1942, he has conducted extensive research studies on reinforced and prestressed concrete bridges, dams, and various statically indeterminate structures.

Mr. Guyon will tell of "Recent Developments and Research Activities in Prestressed Concrete in Europe." Methods of design, including limit design, are discussed. Results of laboratory tests and research work are presented, with particular reference to shear resistance and behavior of statically indeterminate systems.

**A. M. Haas,** professor of concrete and concrete construction at the Institute of Technology, Delft, Netherlands, graduated in 1921 and received his doctor's degree in 1948 from the Institute. He worked until 1927 for Barney-Ahlers Construction Corp., New York, then was engaged in road and building construction in the Netherlands. From 1929 to 1939, he was in the Netherlands East Indies in various phases of concrete construction including water works, industrial buildings, and dams. Returning to the Netherlands, he was a chief engineer and technical director in concrete construction until he joined the faculty at Delft in 1953. He is president of the Netherlands Concrete Association and of the Netherlands Committee for Concrete Research.

Professor Haas will discuss "Theory and Research in Concrete Shell Design." The design of shells by the classical theory is reviewed as a basis for the presentation of simplifications to reduce the complexity of calculations. Research data are presented to clarify the behavior of shells having various schemes of reinforcement, show the stiffening influence of edges, and illustrate types of failure.

**C. F. Kollbrunner,** managing director of Conrad Zschokke, Ltd., steel constructors, Doettingen and Zurich, Switzerland, graduated with the degree of Civil Engineer from the Swiss Federal Institute of Technology in 1931 and later received the Doctor of Technical Science degree. He did research and lectured on structural engineering until 1936, when he became a scientific collaborator at the Center for Geotechnical Study and Research in Paris. From 1937 until 1943, he was head of the department of civil engineering (foundation and consolidation) of Messrs. Brunner and Cie., contractors of Zurich. He assumed his present position in 1943. Mr. Kollbrunner will present a paper on "Steel Buildings and Fire Protection in Europe." Research and recent developments in steel building construction in Europe are discussed, including welding problems with basic and acid electrodes, automatic and erection welding. The behavior of steel under the influence of fire is examined.

**C. E. L. Massonnet,** professor of theoretical and applied mechanics at the University of Liége, Belgium, graduated with the degree of Civil Engineer in 1936. He has been a member of the faculty there since 1945, and a professor since 1950. He has received many scientific awards, including a gold medal from the Belgian Society of Engineers. He has been a visiting professor at the University of Illinois and the University of California at Los Angeles. Mr. Massonnet will talk on "Stability Considerations in the Design of Steel Structures," in which he traces the recent evolution of steel structures from the viewpoint of stability. Principles for minimum weight and optimum design are discussed. Considerations of stability are given for the design and behavior of linear structures, structures composed of plates, and those containing shells.

Y. Guyon

A. M. Haas

C. Kollbrunner

C. Massonnet

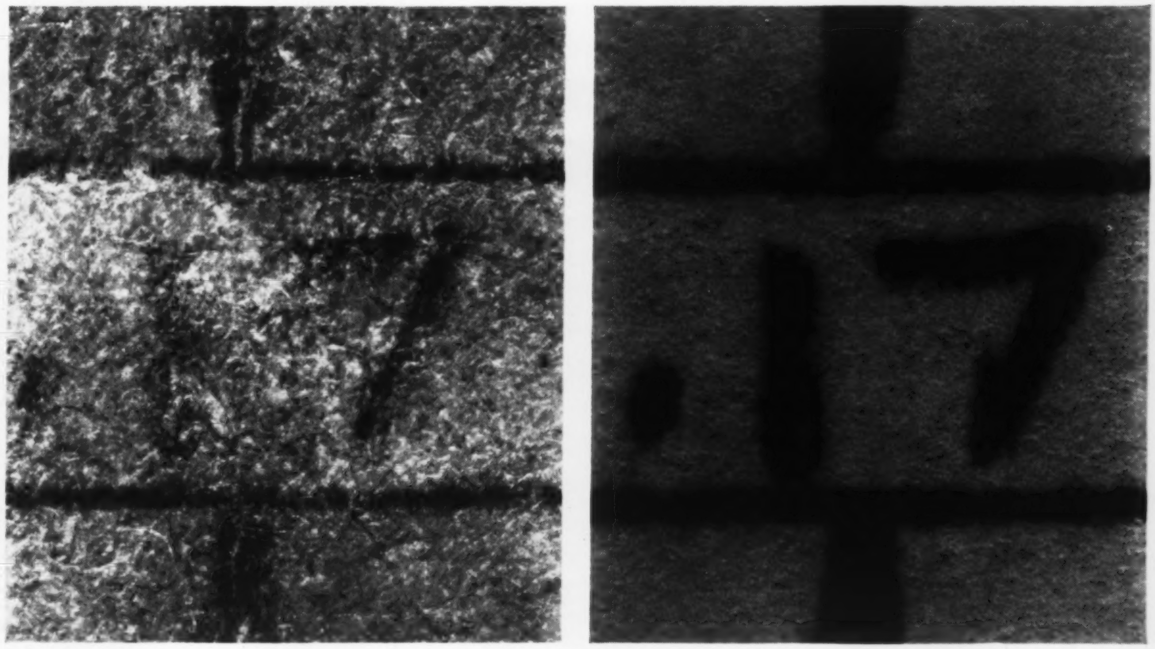
G. Oberti

H. Rusch

**Guido Oberti,** professor of structural engineering at the Polytechnic School of Turin and director of the Experimental Institute on Models and Structures, Bergamo, Italy, holds electrical and concrete specialist degrees from the Polytechnic School of Milan and a doctorate in applied mathematics from the University of Milan. Since 1938, he has been a professor of structural engineering, first in Milan and later in Turin. He has been consulting engineer on the design and construction of many important Italian dams. These include: Lumiej arch dam (1947); Val Gallina dome dam (1949); Forte Buso arch-gravity dam (1950); Ponte Racli (1950) and Corlo (1952) dome dams; Cancano dam in collaboration with Professor Contessini (1953); Beauregard dam in collaboration with Gentile (1954); and Vajont dam in collaboration with Semenze (1955).

Professor Oberti will discuss "Modern Trends in the Design of Italian Arch Dams and Model Confirmation." This paper deals with the association of art, experience, and science in the design of large dams. Experience is shown to be important in etsablishing the type of dam to be built, while the artistic sense of a designer serves as a guide to the aesthetic and rational solution of the problem. The principal static characteristics of arch dams in Italy are summarized, and the work of the Experimental Institute for Models and Structures is described.

**Hubert Rüsch** is professor of reinforced concrete and bridge building and director of the Laboratory for Testing Building Materials and Structures, Institute of Technology, Munich, Germany, from which he graduated in civil engineering in 1926. He worked in shell design, pre-



These photomicrographs show effects of identical handling on (l.) a pencil drawing and (r.) an Autopositive Paper intermediate made from same drawing

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fabricated elements, and prestressed concrete for Dyckeroff and Widmann K.G. In 1938, together with several others, he received the Edward Longstreth Medal of the Franklin Institute, Philadelphia, for his work in shell design. His research influenced to a great extent the development of the German standard specifications for prestressed construction. He was appointed to his present position in 1948.

Professor Rüsch's paper, "Recent Advances and Research in the Design and Behavior of Concrete Bridges," covers reduction of dead load and cost by use of high-strength concrete and prestressing; designs that reduce the disadvantages of the relatively high dead load of concrete; favorable distribution of internal forces and avoidance of undesired secondary stresses by prestressing; the possibility of using high tensile reinforcing steel with increased bond; and reduction of formwork costs by new construction methods.

**Frederick S. Snow,** principal of Frederick S. Snow and Partners, consulting engineers, London, England, graduate in civil and mechanical engineering. He worked for Thomas Miller, Dock and Harbor Engineer, specializing in reinforced concrete structures. He was resident engineer for the Midland Bank and then chief engineer for Holland, Hannen and Cubitts, Ltd., where he was responsible for construction of many notable commercial buildings and industrial structures. He was especially associated with deep foundation work in and around London. The firm he founded in 1943 has done a wide variety of work in steel and concrete structures, including foundations, river and harbor structures, power plants, and various industrial and civil buildings. Mr. Snow's paper, entitled "Recent Developments and Research in Reinforced and Prestressed Concrete in Great Britain," describes the results of recent fire tests on prestressed concrete and their value to industry. Examples are given of prestressed and reinforced concrete bridges, shell construction, multi-story municipal flats and other multistory structures, industrial plants and airfields (particularly Gatwick Airport), and problems encountered in the field and the methods adopted for overcoming them. Suggestions are made for a field of research in which the United States and Great Britain could collaborate.

**Fritz Stüssi,** professor of wood and steel construction at the Swiss Federal Institute of Technology, Zurich, Switzerland, graduated with the degree of Civil Engineer and received the Doctor of Technical Science degree in 1930. He was an assistant to the professor for bridge construction and structural statics at the Institute of Technology until 1926, when he became chief of the technical office of A. G. Conrad Zschokke in Doettingen. He worked for the Port of New York Authority in 1930, then returned to Switzerland with Eisenbaugesellschaft, Zurich, where he was chief engineer in 1934. He became a lecturer at the Swiss Federal Institute of Technology in 1935, and a professor in 1937. From 1949 to 1951 he was Rector of the Institute. He was general secretary of IABSE and has been its president since 1951.

Professor Stüssi's paper is titled "Theory and Test Results on Fatigue of Metals." The fatigue problem of metals is of increasing importance in civil engineering, as well as for machines and airplanes. A theory of fatigue is needed to coordinate the test results and to draw the necessary conclusions for practical applications. Such a theory is developed step by step starting with the simplest cases. The first step concerns the fatigue behavior of unnotched bars from a material without creep, such as steel at ordinary temperatures. From the S-N curves, representing four unknowns, the whole behavior of such a bar can be described. For steel at elevated temperature and a light alloy at normal temperature, a creep occurs that is, the ultimate tensile strength diminishes with increasing loading time. By introducing a fifth unknown, this behavior can be related to the basic case. The next step concerns the influence of notches and holes on the fatigue strength; a simple relation between the behavior of notched and unnotched bars is given.

**Georg Wästlund** is professor of bridge building and structural engineering at the Royal Institute of Technology, Stockholm, Sweden, and director of the Swedish Cement and Concrete Research Institute, Stockholm. He is technical adviser to IABSE, a member of the bureau of the European Concrete Committee, and was president of the RILEM Symposium on Bond and Crack Formation in Reinforced Concrete in Stockholm in 1957.

His paper, "Some Stability Problems Concerning Compressed Steel Members and Arch Bridges," discusses a proposal concerning the design of compressed steel members (columns) assuming a nominal standard eccentricity of the member, as earlier proposed by other authors. Two doctoral theses are reviewed. The first deals with the stability of bridge arches in the vertical plane. A method is shown for computing the increment of live-load moment due to elastic deflections of the arch. Numerical values for practical use are given. The second thesis deals with the lateral stability of bridge arches braced with transverse bars.

**Pierre Lardy,** professor, division for structural statics, Swiss Federal Institute of Technology, Zurich, Switzerland, has prepared a paper, "Methods of Calculation in Civil Engineering" to be presented in absentia. The evolution and classification of methods of calculation are described. A general view is given of the importance of vigorous analytical methods of calculation are described. A general view is given of the importance of vigorous analytical methods, analogies, numerical methods, computations of failure, and experimental investigation. Problems of two-dimensional structures are dealt with, particularly of reinforced concrete and prestressed concrete structures.

*Biographical sketches of the American speakers with brief comment on their papers will be given in September* CIVIL ENGINEERING. *Watch for the article and the complete convention program.*

## ASCE QUARTERLY ENGINEERING SALARY INDEX

**Consulting Firms**

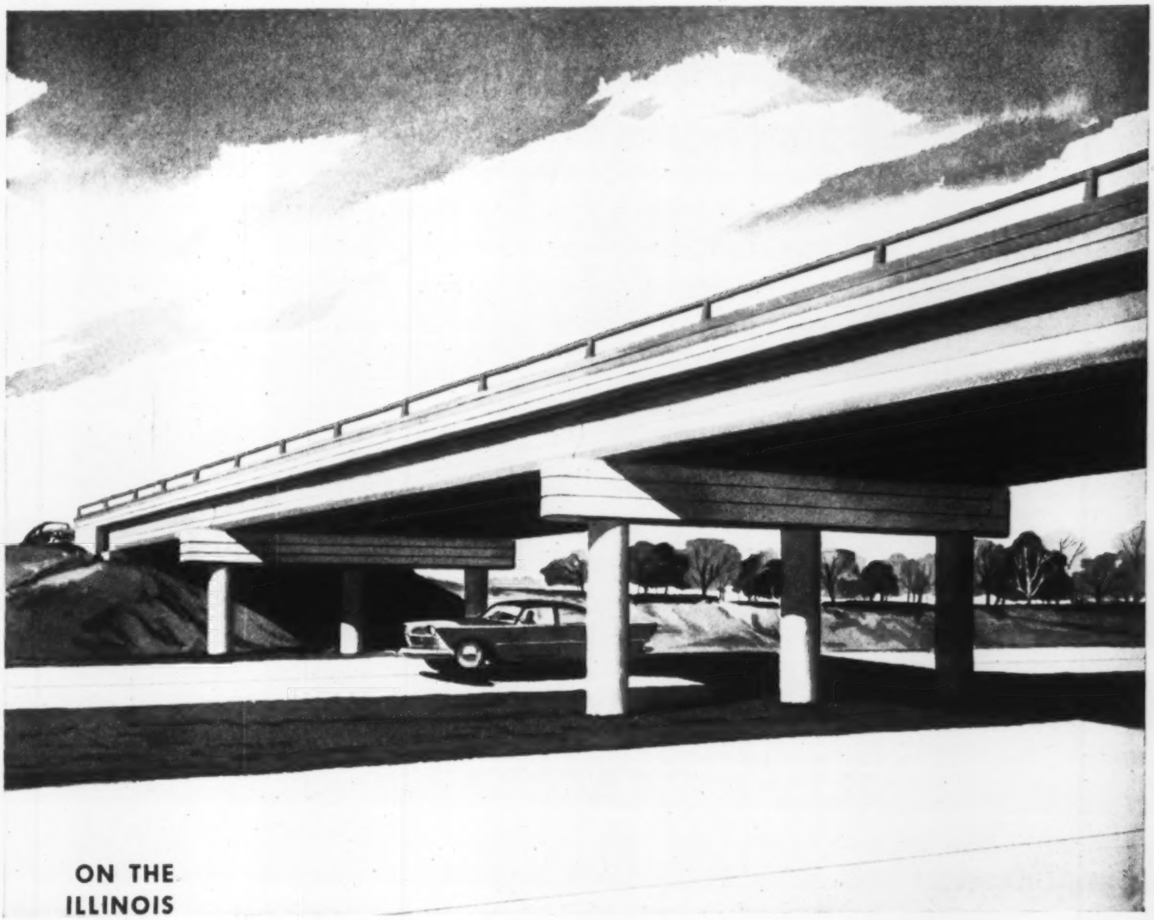
| CITY | CURRENT | LAST QUARTER |
|---|---|---|
| Atlanta | 1.11 | 1.11 |
| Baltimore | 1.11 | 1.11 |
| Boston | 1.15 | 1.13 |
| Chicago | 1.30 | 1.26 |
| Denver | 1.22 | 1.19 |
| Houston | 1.12 | 1.08 |
| Kansas City | 1.14 | 1.14 |
| Los Angeles | 1.16 | 1.16 |
| New York | 1.20 | 1.17 |
| Pittsburgh | 1.05 | 0.93 |
| Portland (Ore.) | 1.15 | 1.15 |
| San Francisco | 1.19 | 1.17 |
| Seattle | 1.06 | 1.07 |

**Highway Departments**

| REGION | CURRENT | LAST QUARTER |
|---|---|---|
| I, New England | 0.91 | 0.85 |
| II, Mid. Atlantic | 1.17 | 1.17 |
| III, Mid. West | 1.25 | 1.15 |
| IV, South | 1.09 | 1.07 |
| V, West | 1.00 | 0.97 |
| VI, Far West | 1.15 | 1.15 |

Figures are based on salaries in effect as of May 15, 1958. Base figure, the sum of Federal Civil Service, G. S. Grades 5, 7, and 9 for 1956, is $15,930.

**WHEN AMERICA BUILDS FOR ECONOMY... IT BUILDS WITH CONCRETE**



# ON THE ILLINOIS TOLL HIGHWAYS... precast, prestressed concrete for bridges will reduce costs $4,000,000

**A full-scale test bridge showed engineers new ways to cut costs. 218 more prestressed bridges will follow . . . at savings that make every fifth bridge free!**

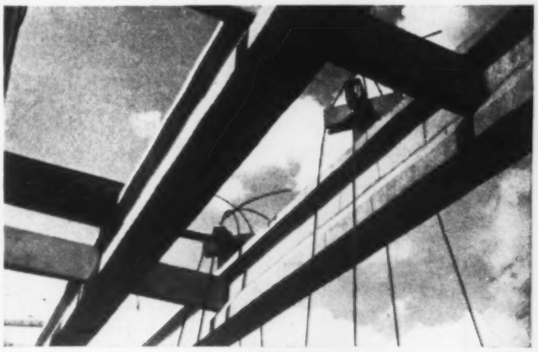
Engineers found big economy when they checked prestressed concrete for bridges on Illinois Toll Highways. They're cutting approximately $4,000,000 from original estimated costs—with no sacrifice of strength or durability.

This is a mass production job, the biggest yet of its kind. Designs are standardized. Prestressed stringers are being produced in casting yards to achieve top economy and uniformly high quality. All this enables contractors to meet road opening schedules with resultant financing economies.

Whether the job calls for hundreds of bridges or just a few, savings really add up with prestressed concrete. And savings are just starting! Maintenance costs will be the lowest known on any major bridge system. That's why you'll be seeing more such modern bridges as Interstate System construction moves ahead.

**PORTLAND CEMENT ASSOCIATION**

*A national organization to improve and extend the uses of concrete*



*Beverly Road test bridge. Tests proved value of prestressed concrete for economical highway bridges.*

**FOR STRUCTURES... MODERN**
**concrete**

# THE YOUNGER VIEWPOINT

## The Voice of the Committee on Junior Member Publications

Milton Alpern, Chairman; 3536 Northview Ave., Wantagh, L. I., N. Y.

| Zone I | Zone II | Zone III | ZONE IV |
|---|---|---|---|
| Harry Morgan<br>266 Malden Place<br>Staten Island, N. Y. | Raymond S. Gordon<br>State Planters<br>Bank Building<br>Richmond, Va. | Walter D. Linzing<br>4751 No. Pauline<br>Chicago 40, Ill. | Rodney P. Lundin<br>9744 Quakertown Ave.<br>Chatsworth, Calif. |

This is the first of a new series of monthly articles that will be devoted to reporting on current younger thinking and doing in ASCE circles. It will be your voice and mine to use as we will.

The feature is being started in hope of improving the communication of the news and ideas of younger members among all members of the civil engineering profession. Both younger engineers and those with young ideas are particularly invited to use this space to speak their mind on any aspect of the profession (others will be given equal space when necessary).

The mechanism will be as simple as possible:

Send your comment, question, or picture report to the committee-member in your Zone or directly to the chairman listed above. Any contribution will be welcome. The committee is normally lazy and only wants to function where necessary to properly serve the profession. We hope that you will begin to think of this column as the "vox pop" and "town hall" for the dissemination of news of younger members and of young ideas into the civil engineering profession. We hope to—as Walter Linzing suggested: ". . . print material that is both current and controversial; appeal to the emotions, ideals, practical problems and predjudices. . . ." We would hope to probe to the core of the good and bad of our profession as the young engineer sees it.

Remember though—this will be *your* column. There is and will be no "clique" to run it. Your letters will form the major portion of the articles.

Now sound off!

**Our first formal letter:**

"Dear Mr. Alpern:

"We as Junior Members of the Illinois Section of ASCE welcome the opportunity to express our views in this special feature of CIVIL ENGINEERING. We look forward to exchanging ideas and opinions with other Junior Members across the nation.

'The first question we raise is, 'How do other Local Sections of ASCE encourage participation of more Junior Members in their Local Section activities?' Our experience has been that, in general, Junior Members shy away from Local Section activities.

"There is another observation which we would like to bring under discussion. As Junior Members of ASCE we have found that our employers are reluctant to send us to the national Conventions of ASCE. There are many interesting technical papers being presented that we would like to hear first-hand. We would also like to meet other engineers at these meetings. ASCE Conventions should be held for the benefit of *all* members of ASCE, not a privileged few. Yet there is a preponderance of Associate Members and Members attending. The few Juniors present at Conventions consist of the Local Section men who, even in their own cities, are not really encouraged to attend by their employers. It takes understanding and money on the part of engineering management to assist Junior Members in attending these national meetings. They, too, would like to develop professionally and participate in ASCE meetings.

"K. R. Leonardson
W. D. Linzing
Chicago, Ill."

**News item: The Junior Forum of the Los Angeles Section believes that it is the oldest Junior organization having held its first meeting on March 12, 1930. Any objections?**

"Dear Mr. Alpern,

"Last month . . . I learned of an activity of the American Society of Mechanical Engineers . . . that the ASME National Junior Committee publishes a monthly article entitled, "Junior Forum" in *Mechanical Engineering* . . . The article in the May issue was quite well done and interesting. . . .

"Trent R. Dames
Los Angeles, Calif."

Do you realize that:

- **In the May issue of "Civil Engineering" on Computation, four articles were authored by Junior Members?**

- **There are over 17,000 Junior Members in ASCE—about 43% of the membership?**

- **At the Portland Convention about ten technical papers and discussions were presented by Junior Members?**

- **The 1957 Transactions of ASCE is enhanced by ten Junior Members as Co-Authors of papers?**

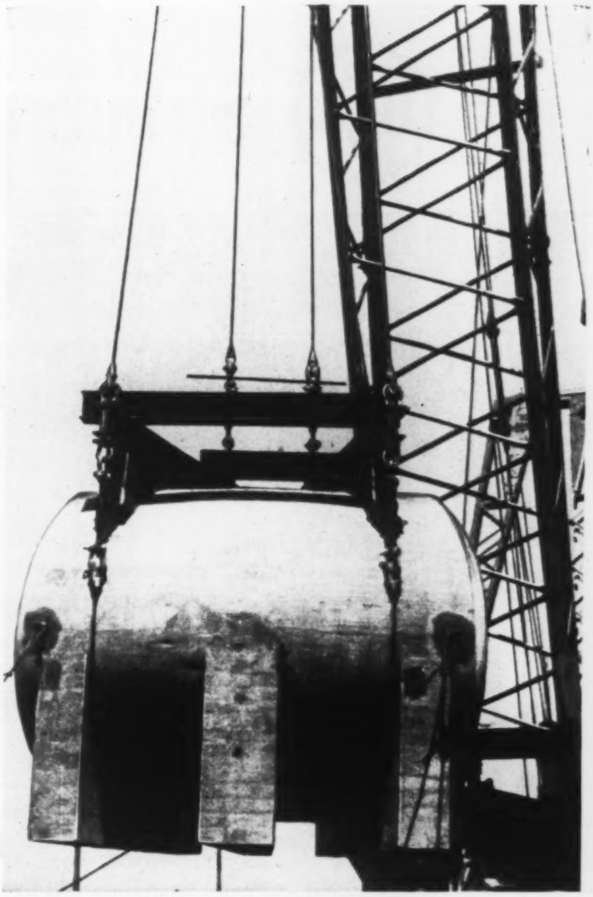
Have you seen the following splendid articles of interest to Younger Engineers? . . . Worth reading! !. . . .

1. December 1956, CIVIL ENGINEERING, page 35, by W. J. Carroll, "Junior Member Organizations Play Valuable Role."
2. "Do Local Sections Interest Junior Members?" January 1957, page 76, by ASCE Committee on Junior Members.
3. Junior Forums, "Originated with Los Angeles Section," May 1957, page 80 (photo) and August, page 64, "Letter to the Editor" by Archer F. Barnard.
4. "The Young Engineer in ASCE—A Project," July 1957, page 497, W. H. Wisely, Executive Secretary.

*And now in closing, we would like to request some help from you 17,000 and more young engineers. The heading for this column is tentative. Many suggestions, in addition to the heading used, have come to us—"Spotlight on the Young Engineers," "News and Views of the Younger C.E.s," "The Voice of the Junior Member," "Young Lines," and many others have been suggested. What can you think of that will be eye-catching and meaningful in a few words.*

# with SUBAQUEOUS PIPELINE INSTALLATION

from "forms" to final "fill"



## ...it's **MACCO** all the way!

The old chestnut, "Time and tide wait for no man", certainly applies to subaqueous pipeline installation. That's why it's so important that this type of project be handled by MACCO—the one company with job-bred know-how, versatility and engineering ingenuity gained through 30 years' experience. Wherever—and whenever special equipment or materials have been needed, MACCO's resourceful planning has solved the problem in the best manner.

For example: When two 34°—60-ton precast concrete elbows were needed as part of a recent subaqueous project, MACCO men fabricated giant forms and cast these massive elbows on the job site—an incidental item to the laying of 2050 feet of 10′ ID concrete subaqueous pipeline.

Solving construction problems *is* a MACCO specialty! MACCO has the experience, specialization and diversification necessary to design and construct your requirements economically—and in the shortest possible time.

That's why we say, "We're capable—and we're interested in working for you!"

**MACCO**

**MACCO CORPORATION**

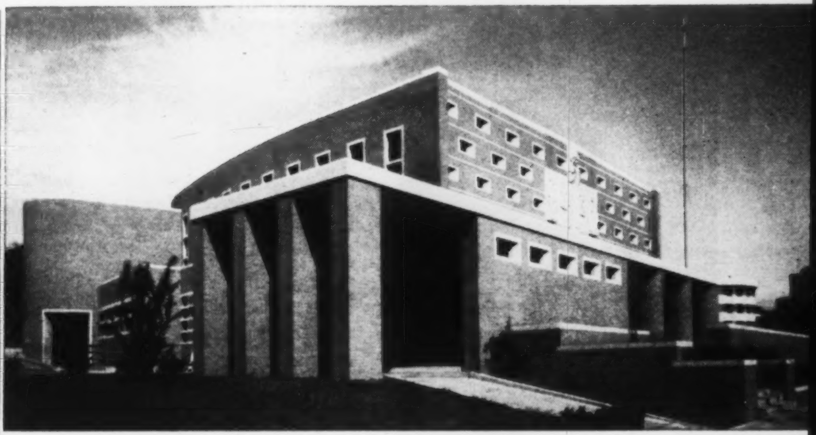
14409 South Paramount Boulevard • Paramount, California

**RECENT MACCO SUBAQUEOUS PIPELINE PROJECTS**

| | | | |
|---|---|---|---|
| SCATTERGOOD STEAM GENERATING PLANT | STEAM GENERATING PLANT | STEAM GENERATING PLANT | STEAM GENERATING PLANT |
| Playa del Rey, California<br>for Los Angeles<br>Department of Water and Power | Huntington Beach, California<br>for Southern California<br>Edison Company | El Segundo, California<br>for Southern California<br>Edison Company | Redondo Beach, California<br>for Southern California<br>Edison Company |

# Structural Steel for church

# erected in 10 days



**St. Catherine of Sienna Church,** St. Louis, Mo. Architects: Carroll & Dean; Structural Engineer: John P. Nix; General Contractor: M. J. Lawlor; Structural Steel Fabricator: Mississippi Valley Structural Steel Co.

**The use of** USS* Structural Steel for the new St. Catherine of Sienna Church in St. Louis accomplished four purposes. First, it permitted a beautiful modern design unobstructed by columns and shaped for good acoustics. Second, it speeded up construction. The steel was fabricated in three weeks and erected in 10 days. Third, it assured maximum strength, safety and durability. Fourth, it kept costs low.

Structural steel is a versatile material that lends itself to modern construction. It can be easily fabricated for domes, arches and long roof spans. Where weight is a problem, the new high-strength steels such as USS TRI-TEN* brand permit lighter construction without sacrifice of strength. These steels can be formed, welded or riveted in much the same manner as regular structural carbon steel.

**QUICK DELIVERIES!** Recent expansion of production facilities assures quick deliveries and continuing availability of steel shapes and plates to accommodate the increasing demands of the construction industry. Just call the nearest office of United States Steel. The telephone number is listed in local directories.

For your copy of "Hot Rolled Carbon Steel Shapes and Plates," a handbook containing details, dimensions and weights—write to United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

◀ **Auditorium roof** fabricated from USS Structural Steel in three weeks and erected in 10 days, using standard shapes and plates.

United States Steel Corporation – Pittsburgh
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
United States Steel Supply – Steel Service Centers
United States Steel Export Company

## United States Steel

*TRADEMARK

## Wide Coverage of Applied Mechanics Marks National Congress

**Among those taking the trip to the U. S. Naval Base at Newport are (reading left to right): D. C. Drucker, vice-chairman of Engineering Mechanics Division Executive Committee and Congress secretary; E. Wenk, Jr., incoming secretary of the Executive Committee; J. S. McNown, chairman of the Executive Committee; E. P. Popov, member of the Executive Committee; M. P. White, present secretary of the committee; Dr. Wallace R. Brode, science adviser to the Department of State and featured banquet speaker; and Don Reynolds, assistant to the Executive Secretary of ASCE.**

Subjects covered at the recent Third National Congress on Applied Mechanics ranged from buckling to waves. Civil engineers were treated especially well, with a dozen sessions and fifty papers devoted to their interests and needs. The congress, which was held at Brown University, June 11-14, brought together over 500 engineers and scientists from nearly 100 educational institutions, industries, and engineering offices. All the sessions were held on the Brown campus, with the exception of a notable tour of the U.S. Naval Base at Newport and a dinner as guests of the Navy at the Officers' Club there.

The congress featured four general lectures, at which invited specialists presented scholarly appraisal of the subjects in question. These general subjects were: "Creep" by Prof. N. J. Hoff, of the Stanford University engineering staff and chairman of the U.S. National Committee on Theoretical and Applied Mechanics; "Some Aspects of Boundary-Layer Flow in Subsonic and Supersonic Air Streams," by Dr. Hugh L. Dryden, of the National Advisory Committee for Aeronautics; "Linear Thermodynamics and the Mechanics of Solids," by Dr. M. A. Biot, of the Shell Development Co.; and "Rotationally Symmetric Problems in Shell Theory," by Prof. E. Reissner, of Massachusetts Institute of Technology.

For structural engineers, there were sessions on the buckling of plates, elastic plates, curved beams, elastic beams, shells, creep, inelastic behavior, and dynamic response of structures. For hydraulic engineers, there were sessions on fluid flow, hydrodynamics, wave propagation, and fluid mechanics.

The 101 papers and discussions presented will be available to the profession in the published Congress Proceedings, which may be purchased at $20 a copy. Orders should be sent to the ASME, 29 West 39th Street, New York 18, N. Y., the publisher for the congress.

One of the important aspects of the congress was that it seemed to stimulate an unusual amount of discussion. Especially thought provoking was a talk with a sociological emphasis, presented by Dr. Wallace R. Brode, science adviser to the U.S. Department of State. Dr. Brode discussed the Department's program for exchange of visitors with the Iron Curtain countries. Several scientists and engineers included in the program attended the congress and were able to give first-hand accounts of visits to Russia and the satellite nations. The State Department is currently emphasizing the exchange program, which promises to include many ASCE members.

New congress officers are Prof. Nicholas J. Hoff, chairman, and Dr. Walter Prager, vice-chairman. Prof. Daniel C. Drucker, vice-chairman of the ASCE Engineering Mechanics Division, was secretary for the Third Congress, and Prof. Robert M. Haythornthwaite served as chairman of the Editorial Board for the Congress.

The next national congress will be held at the University of California's Berkeley campus in June 1962.

## E.S.P.S. Endorsed as Federal Recruiting Agency

Recruitment of engineers for federal agencies through the Engineering Societies Personnel Service has now been approved by the U. S. Civil Service Commission. The new policy—set forth in the Commission's Departmental Circular No. 949—permits the use of certain employment agencies for federal recruiting and specifically mentions the E.S.P.S. as an example of a non-profit professionally sponsored employment service empowered to recruit engineers and scientists for federal agencies. It is expected that the new policy will make it easier for the government to fill specialized engineering and scientific positions.

In order to preserve the basic principle that no one shall be required to pay a fee to secure federal employment, each agency will make its own arrangements and execute its own agreement to pay the participating employment services any fees charged for successful placement. The new policy permits E.S.P.S. to render the same assistance to government agencies it has provided to private employers for the past forty years.

WEDNESDAY
1958
Completed on time
CONCRETE REINFORCING STEEL INSTITUTE
C.R.S.I.
FOUNDED 1924

## Stay on schedule with REINFORCED CONCRETE

Whether a simple overpass or a complex four-level highway separation structure, you can count on its being open for traffic on time when you design in reinforced concrete.

First, you know that your materials and labor are available "on location" . . . ready to start and proceed to completion. Second, necessary field changes can be made without costly delays.

Reinforced concrete offers many other advantages, too . . . it is rugged, highly resistant to weather and shock. Reinforced concrete structures are lower in first cost and require lower maintenance. Compare . . . and you will save with reinforced concrete.

Petaluma Creek Bridge, illustrated above, was designed by the Division of Highways, Sacramento, California.

*Concrete Reinforcing Steel Institute*
*38 S. Dearborn St., Chicago 3, Ill.*

## Schneller Joins CIVIL ENGINEERING

Francis J. Schneller, Jr., J.M. ASCE, for the past year assistant editor of ASCE Technical Publications, has become assistant editor of CIVIL ENGINEERING. Mr. Schneller will assist in all phases of the magazine's publication. His addition to the staff is in line with Society policy of continued improvement in service to members.

A civil engineering graduate of the College of Engineering at Rutgers University in 1956, Mr. Schneller was active in the Student Chapter and was managing editor of *The Rutgers Engineer.*

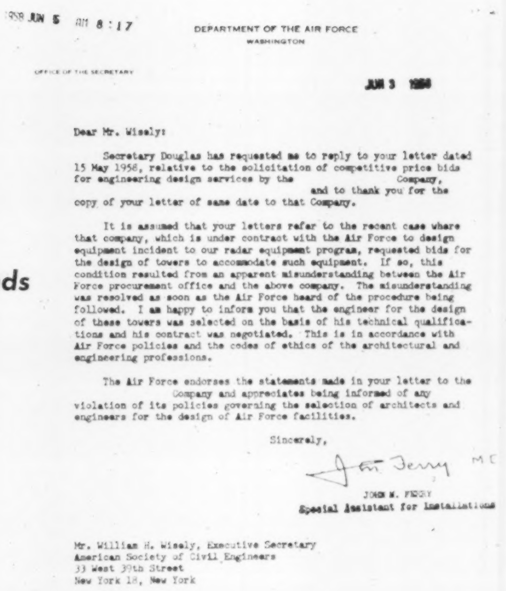
**Frank J. Schneller, Jr.**

Immediately after his graduation, Mr. Schneller joined the Bethlehem Steel Company in the Loop training program at the Baltimore, Md., works. Mr. Schneller has completed a tour of duty in the Corps of Engineers at Fort Belvoir.

### ASCE Membership as of July 9, 1958

| | |
|---|---|
| Members | 10,029 |
| Associate Members | 13,983 |
| Junior Members | 17,181 |
| Affiliates | 76 |
| Honorary Members | 44 |
| Total | 41,313 |
| (July 9, 1957 | 40,073) |

## Air Force Commends ASCE on Its Bidding Policy



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DEPARTMENT OF THE AIR FORCE
WASHINGTON

OFFICE OF THE SECRETARY

JUN 3 1958

Dear Mr. Wisely:

Secretary Douglas has requested me to reply to your letter dated 15 May 1958, relative to the solicitation of competitive price bids for engineering design services by the Company, and to thank you for the copy of your letter of same date to that Company.

It is assumed that your letters refer to the recent case where that company, which is under contract with the Air Force to design equipment incident to our radar equipment program, requested bids for the design of towers to accommodate such equipment. If so, this condition resulted from an apparent misunderstanding between the Air Force procurement office and the above company. The misunderstanding was resolved as soon as the Air Force heard of the procedure being followed. I am happy to inform you that the engineer for the design of these towers was selected on the basis of his technical qualifications and his contract was negotiated. This is in accordance with Air Force policies and the codes of ethics of the architectural and engineering professions.

The Air Force endorses the statements made in your letter to the Company and appreciates being informed of any violation of its policies governing the selection of architects and engineers for the design of Air Force facilities.

Sincerely,

JOHN M. FERRY
Special Assistant for Installations

Mr. William H. Wisely, Executive Secretary
American Society of Civil Engineers
33 West 39th Street
New York 18, New York

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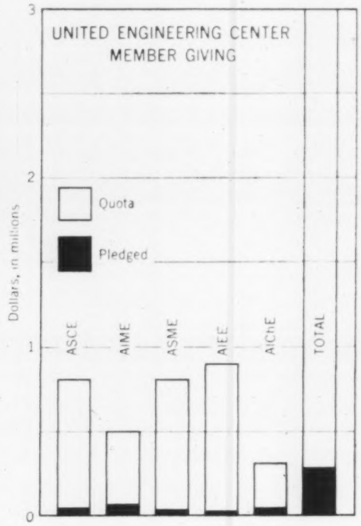
## Status of Member Giving for UEC



**This chart shows graphically the status, as of July 14, 1958, of the Member Giving Campaign for the $10 million United Engineering Center in New York. Of the $3,000,000 goal accepted by the Five Founder Societies as their share to be raised by voluntary member giving, over $275,000 has been received in pledges and cash. Past President E. R. Needles, chairman of ASCE's Member Giving Committee, is optimistic about raising ASCE's $800,000 share. Under the leadership of Dr. M. J. Kelly, the National Industry Campaign is actively seeking to raise $5,000,000. Of this, $3,400,000 in pledges and cash were on hand on July 14, 1958. The site for UEC on United Nations Plaza has been purchased and cleared; general architectural plans are underway; and agreements with the associate societies who desire to occupy the building are being hammered out.**

---

## Holly Cornell New Head of Pacific Northwest Council

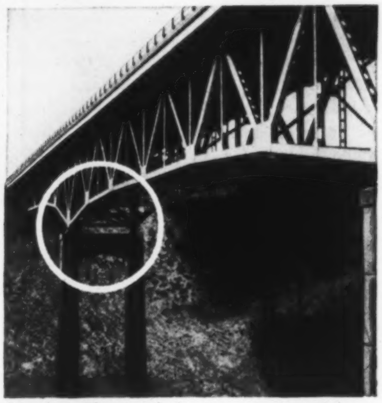
Holly Cornell, of Corvallis, Ore., was named chairman of the Society's Pacific Northwest Council during the Portland Convention. This year the Council's annual conference was held concurrently with the Convention.

Jack Y. Barnes, of Helena, Mont., was named vice-chairman of the Council, and Oliver J. Domreis, of Portland, was elected secretary-treasurer of this active group.

Mr. Cornell, a member of the consulting engineering firm of Cornell, Howland, Hayes and Merryfield, succeeds Glenn H. Von Gunten, of Walla Walla, Wash., as chairman.

Devoted to study of Society and professional problems at local level, the Pacific Northwest Council includes the Local Sections in Alaska, Columbia, Montana, Oregon, Seattle, Southern Idaho, Spokane, and Tacoma.

# A Must on the Big Ones...



**Bearing Plates** of the Greater New Orleans Mississippi River Bridge (top photo), like those of the considerably smaller Pennsylvania Turnpike Bridge, are of safe, economical Lukens clad steel.

# ...Insurance on the Small!

## LUKENS STAINLESS-CLAD STEEL BEARING PLATES GIVE SAFETY, ECONOMY, LOW MAINTENANCE!

Trouble-free movement of bridges on their supports is assured with bearing plates of stainless steel. Lukens Stainless-Clad Steel Bearing Plates provide all of the essential corrosion protection of solid stainless—at markedly lower first cost.

That's why Lukens Bearing Plates are specified for more and more bridges, large and small. To meet varying bridge design demands, particularly as to strength, two types of Lukens Clad Steel Bearing Plates are available. The standard type provides a minimum yield of 30,000 psi. A higher strength plate—incorporating A-302, Grade B backing steel for larger bridges—will meet a 50,000 psi minimum yield requirement. All bearing plates can be supplied flattened and machined on both sides to within .010 inch of dead flat.

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CLAD STEEL
BEARING
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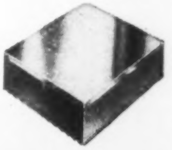
LUKENS

**For details,** write—Manager, Marketing Service, 162 Lukens Building, Lukens Steel Company, Coatesville, Pa. Ask for special bulletin 180.



**LUKENS clad steel** is a solid plate—one surface corrosion-resistant metal permanently bonded over all to an economical backing steel.

LUKENS ®

# Division Doings

### Symposium on Physico-Chemical Properties of Soils

Recent developments in knowledge of the physico-chemical properties of soils have been so extensive and significant that a special program has been planned for the Annual Convention in New York to review these developments and to assess their practical utility. Two sessions will be held on Thursday, October 16, one in the morning and the other in the afternoon.

At the first session, on Thursday morning, Ralph E. Grim, research professor of geology at the University of Illinois, will review the composition, structure, origin, and means of identifying the clay minerals. The latest information and techniques will be explained. Paul F. Kerr, professor of mineralogy at Columbia University, will discuss the paper.

"Ion-Exchange Phenomena" will be presented by Dr. A. W. Taylor, Division of Chemical Development, Tennessee Valley Authority. After reviewing the basic phenomena involved, Dr. Taylor will present the experimental methods for study and measurement of exchangeable ions and exchange capacities of soils. The relationship between these phenomena and the physical properties of soils will then be explained. The paper will be discussed by Philip P. Low, professor of agronomy at Purdue University.

At the second session, on Thursday afternoon, Prof. I. Th. Rosenqvist, of the University of Oslo, will present the results of recent research on the nature of the clay-water system. Stereoscopic slides of the structure of clay obtained with the electron microscope will be shown. A new theory for the shearing resistance of clay will be suggested. Alan S. Michaels, associate professor of chemical engineering at Massachusetts Institute of Technology, will discuss the paper. T. W. Lambe, head of the Division of Soil Engineering at Massachusetts Institute of Technology, will summarize and appraise the material presented in the three previous papers and assess its practical utility to the civil engineering profession.

The Symposium will be concluded by open discussion from the floor, and ample time will be allotted for thoroughly airing differences of opinion. Engineers concerned with the use of soil—irrespective of their particular area of interest—will find this symposium an informative and inspiring occasion.

## Pipeline Division Committee on Pipeline Crossings Meets

**Recently members of the Pipeline Division's Committee on Pipeline Crossings of Railroads and Highways met in Columbus, Ohio, for a three-day session. The meetings were attended by representatives of 32 committees. Photographed here (front row, usual order) are D. A. Roach, chief engineer of the Phillips Pipeline Co., Bartlesville, Okla.; Edwin F. Trunk, M. ASCE, chief engineer of the Laclede Gas Co., St. Louis; Chairman J. E. Thompson, A.M. ASCE, superintendent of pipeline construction for the Natural Gas Pipeline Company of America, Chicago; E. A. Slade, president of the Okan Pipeline Company, Tulsa, Okla.; and George D. Mock, engineer of development and design for the Washington (D. C.) Gas Light Company. In back row are Lowell L. Elder, assistant supervisory engineer for the Columbia Gas System Service Corp., Columbus; William B. Haas, superintendent of pipeline for the Northern Natural Gas Co., Omaha, Nebr.; James O. Fisher, A.M. ASCE, senior engineer for the Consolidated Edison Company of New York (representing ASCE); and John T. Wootan, A.M. ASCE, supervisor of contract construction for the Southern California Gas Co., Los Angeles.**

### Conference on Electronic Computation

Here is another reminder of the two-day Conference on Electronic Computation, slated for Kansas City, Mo., November 20 and 21, under joint sponsorship of the Structural Division and the Kansas City Section. The scope of the four half-day programs will be broad enough to interest engineers just getting started in the field as well as advanced users of electronic computers.

The Secretary of the Division's Committee on Electronic Computation is Steven J. Fenves, Civil Engineering Hall, University of Illinois, Urbana, Ill.

### Irrigation and Drainage Conference

Nearer at hand is the Irrigation and Drainage (Division) Conference, which will be held in Memphis, Tenn., September 25-27, during the annual meeting of the Mid-South Section. Among the topics to be dealt with are "Education for Continuous Irrigation," "Design and Value of Small Detention Dams," "Drought Frequencies," and "Water Laws in Humid Areas." Another interesting event will be an aerial field trip over the St. Francis River Basin, a current Corps of Engineers project.

Registrants for the conference will be allowed the privilege of purchasing tickets to watch the Sugar Bowl football champions, the University of Mississippi, playing the University of Kentucky in a night football game on September 27.

# Weldynamics

**ARC WELDING AT WORK CUTTING COSTS**

## Connecticut gets more bridge for the money... with welded steel

*Yankee Doodle Bridge, Norwalk, Connecticut. Seven spans for a total of 910 feet. John F. Willis, State Engineer of Bridges and Structures.*

Since 1938 the State of Connecticut has been realizing savings in steel of 10% to 20% per bridge through welded design.

This is possible because welded bridges require less material, permit placing of steel where it counts . . . to carry the load.

Welded bridges are more attractive too!

The economies of welded design don't stop when construction is completed either. Welded bridges are easier, cheaper to maintain.

Lincoln welding equipment and electrodes add further savings to welded designs with more efficient operation, faster, easier welding.

**Let Weldynamics cut your costs**

**Lincoln men, trained in Weldynamics, will consult with you on design, equipment and procedures. No obligation.**

**Bridge Design Seminars held regularly at our Cleveland plant. Write for details.**

**"Procedure Handbook of Arc Welding Design and Practice" has 1300 pages, 1100 illustrations, 466 pages on structural design. $3.00 postpaid in U. S. A., $3.50 elsewhere.**

**"Studies in Structural Arc Welding" published 4 times a year. Free to designers on request.**

*The World's Largest Manufacturer of Arc Welding Equipment*

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**THE LINCOLN ELECTRIC COMPANY, DEPT. 2418, CLEVELAND 17, OHIO**

# BY-LINE WASHINGTON . . . .

**A strong appeal for increased federal aid** for airport construction was made last month by the Senate Committee on Interstate and Foreign Commerce in advocating renewal of the Federal Airport Act. Chairman Monroney pointed out that:

- The airlines carried 45 million passengers last year, compared with 12½ million ten years ago. The CAA expects air travel to more than double again within the next seven years.
- The volume of air freight has quadrupled in the last decade and is expected to triple again by 1970.
- The popularity of jet liners will require additional engineering at a number of airports. Not one existing airport is at present adequate for current traffic demands. The committee was advised that it costs about $1,000 to add 1 ft to the length of a runway and, therefore, that the extension of a heavy duty runway by 1,000 ft would cost $1,000,000.

*During the next four years,* airport projects are planned at 1,138 locations around the country, a survey by several national associations has revealed. Their estimated cost—$1,066 million. Funds available from local and state sources would come to about $590 million, leaving a deficit of $477 million. Federal-aid advocates claim that Uncle Sam should put up part of this.

*The Airport Program has had an uncertain existence.* Congress set an original goal of $500 million back in 1946, this amount to be expended within seven years. By 1956, however, only $325 million had been appropriated in actual aid. In 1955, the legislators gave the CAA contract authority and made another $231.5 million available for this federal-aid program through fiscal 1959, or a total still short of the original goal, thirteen years later. The *Senate* bill would increase annual authorizations from $63 million to $100 million and set up an additional $75 million fund to be used immediately as an anti-recession measure. The *House* counterpart committee is engrossed in questioning a Mr. Goldfine on unrelated matters and is not eager to forsake the spotlight for airport construction.

(An incidental amendment in the bill which passed the Senate would make seal coating of flexible airport pavements and filling of joints in rigid pavements eligible for federal matching aid on small airports. As a "maintenance" item heretofore it has been borne entirely by the local management.

* * *

**A terse summation of nuclear power plant construction** was given the press by Lewis L. Strauss, AEC chairman, on the occasion of his retirement last month. Mr. Strauss predicted that the number of civilian power reactors installed in this country would be boosted from the eight currently operating to 23 by 1964. Together the existing stations produce 78,000 kw, whereas the plants planned for construction during the next six years will have an output of about 1.3 million kw. Four of these facilities—worth $250 million—are now under construction without any federal assistance. Eight future projects will receive federal funds totaling $150 million.

The Senate has unanimously confirmed John A. McCone as new chairman of the AEC.

*Congress is still considering* a proposal to give financial aid to a group of six European nations, banded together under the name "Euratom," to design and construct a number of nuclear power plants by 1963.

*And looking way ahead,* an independent research organization forecast last month that 10 percent of the power needs of the U. S. will be met by nuclear energy by 1980. The tremendous power appetite of American industry by then will be equal to that derivable from 3 billion tons of coal. Nuclear power development will reduce not only this nation's dependence upon coal but also its dependence upon the oil output of the vulnerable Middle East. Nuclear power will become competitive, cost-wise, the National Planning Association said, in New England, The Upper Midwest and Florida, where coal and oil prices are highest.

* * *

**The Bureau of Public Roads is all primed** to defend its new cost estimate for the National Interstate System. Senator Gore, chairman of the Subcommittee on Roads, had challenged the $40-billion estimate and requested the Government Accounting Office to check the methods eleven key states used in determining their costs. The GAO's report admitted that it could not really evaluate the procedures of individual states, which were largely based on engineering judgment, but did undertake to show that the highway departments varied in their estimating techniques. The BPR has assigned some of its top men to the job of building a case for its cost estimate and expects to convince the dubious legislators of its reliability.

* * *

**A big rivers and harbors omnibus bill,** the first since 1954, was nudged over the legislative finish line finally after weaving through an obstacle course that included lengthy hearings, weeks of debate, and two Presidential vetoes. President Eisenhower signed the $1,556-million authorization bill on advice that his earlier objections had been largely removed.

*Some 139 individual projects are involved* (plus $608 million for basin development). They break down roughly as follows: For flood control jobs, $545 million; for rivers and harbors, $191 million; for beach erosion control, $12 million; and for reclamation projects, $200 million. Sometimes referred to as the "pork barrel" bill, the measure includes authorizations which run from $12,000 for work on the East River near New Haven, Conn., to $50 million for work on the Oroville Reservoir in California.

*Meanwhile, annual appropriation bills* for well over $1 billion for public works of all kinds have been passed by both the House and the Senate. The compromise measure will carry funds for some of the projects authorized in the measure described above and others authorized previously.

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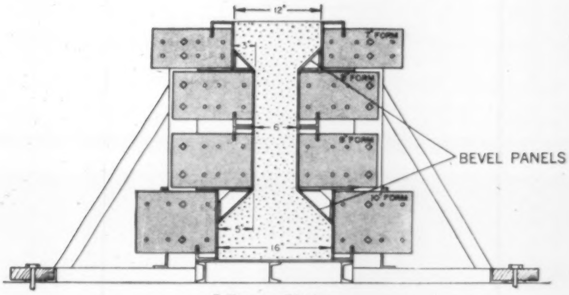
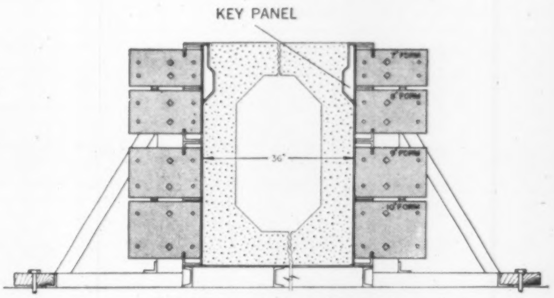
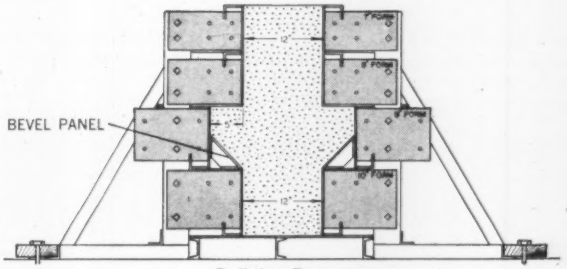


I-Beam Girder



Box Girder, Slab or Channel



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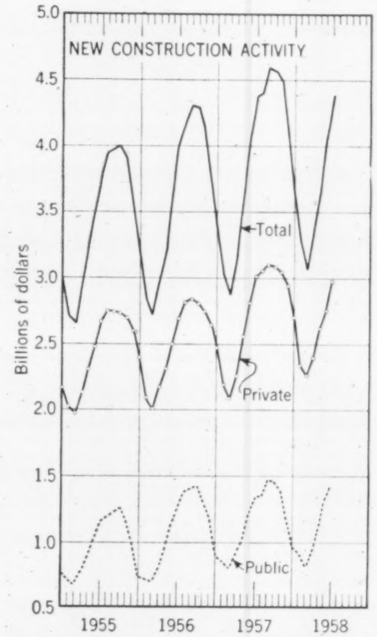
# NEWS BRIEFS . . .

## Half-Year Construction at 1957 Level

The dollar value of new construction put in place rose seasonally in June to nearly $4.4 million, bringing the total for the first half of 1958 to $22.1 billion—about the same as the figure for the comparable period of 1957, according to preliminary joint estimates of the U. S. Departments of Labor and Commerce.

These estimates reflect a 3-percent rise in public construction from the first six months of 1957, due primarily to expanded activity in highways and public housing (mostly Capehart projects for the armed services). Private construction thus far in 1958, at $15.5 billion, was off only slightly from the total for the first half of 1957, despite a sharp drop in outlays for industrial construction.

The joint agencies note that their monthly estimates are determined primarily by past contract award movements, standard progress patterns, and assumed normal seasonal movements. They do not reflect the effects of varying numbers of working days in different months, nor of special conditions influencing the volume of activity in any given month, such as unusual weather, materials shortages, overtime, work stoppages, and postponements. General indicators of future trends in activity are housing starts, contract awards, building permits, and materials output. Analyses of trends of activity should consider all of these interrelated factors.



**Seasonal rise in construction spending in June brings total for first six months to $22.1 billion—about the same as for comparable period of 1957.**

## International Highway Meeting in Mexico City

Road problems will be attacked on a world scale during the week of October 26-31, when engineers and other highway experts and top government officials from fifty countries gather in Mexico City for the International Road Federation's Third World Meeting. Every phase of designing, building, and financing highways, even in the far-off Arab World, India, and Australia, will be studied in the ambitious program. One of the highlights of the meeting will be a big display of highway equipment sponsored by the Mexican Highway Association.

Prior to the meeting, groups of foreign engineers will be taken on tours of industrial installations, highway projects, and highway departments from coast to coast in the United States. Well over 100 have already signed up for the trip, which will start in Washington in late September and end in Mexico City in time for the opening session of the meeting. Details about the program and meeting may be obtained from the International Road Federation, 1023 Washington Building, Washington 5, D. C.

The Federation is a non-profit service organization, which promotes world roadbuilding through its member road associations in 64 Free World nations. One of its important projects is the El Olivar Training Center near Mexico City, which will be visited during the meeting. Since its formation in 1950 as a joint project of Mexico, the U. S. International Cooperation Administration, and the IRF, the Center has trained more than 1,000 highway equipment operators and mechanics.

## Army Starts Closure of Oahe Dam on Missouri

Construction of the final 350-ft section of the nation's largest "rolled-fill" earth dam, Oahe, on the Missouri River near Pierre, S. Dak., began on July 1. Under construction by the Corps of Engineers since 1948, the entire 1¾-mile-long main structure has been completed except for a short gap through which the river still flows. The $380,000,000 dam, of compacted earth, stands 242 ft high and is nearly a mile thick at its base.

To battle the river and close the final gap, always a major engineering feat on a large stream, the contractor—the Western Construction Corp., of Sioux City, Iowa—has had built a special earthmoving vehicle of exceptional speed and size, called the "Eucnik." The giant machine, which stands 14 ft high with a hopper body 46 ft long, can carry 120 tons of earth and rock in a single load at a speed of 35 mph.

Supported by a fleet of the largest bulldozers, trucks, and power shovels available, the Eucnik will work round the clock in a 20-hour battle against the river scheduled to begin on August 3. The vast array of equipment will be called upon to dump 30,000 tons of rock, shale, and earth into the channel fast enough to keep the swift current from washing the material away as fast as it is placed. The temporary barrier of earth and rock will permit drying the river bed by diverting the flow of the Missouri, via six huge concrete and steel tunnels, 3,200 ft long, through the right abutment of the dam. The gap in Oahe will be narrowed to 125 ft between July 1 and August 3, when the closure battle begins.

The new dam will form a lake 250 miles long, stretching from near Pierre to the environs of Bismark. Reservoir capacity will be 23,600,000 acre-ft, making Oahe the third largest dam in reservoir capacity. Oahe power facilities are still to be completed. It will have seven generators, of 595,000-kw combined capacity, and is scheduled to begin producing power in 1962. Sverdrup and Parcel of St. Louis are the consulting engineers for the Corps.

Oahe is the last of the three primary dams to be built under the Pick-Sloan Plan for harnessing the Missouri. The other two dams, Garrison and Fort Randall, are now in service. The main-stem reservoir system includes Gavins Point, a smaller structure completed in 1956; Big Bend, another smaller dam still to be built; and the giant Fort Peck Dam in Montana, built prior to the Pick-Sloan Plan.

## Flaming Gorge Contract Goes to Joint Venture

Work is about to start on Flaming Gorge Dam on the Green River in northeastern Utah, following award of a low-bid contract of $29,602,497 submitted by Arch Dam Constructors, of Omaha, Nebr. Arch Dam Constructors is a joint venture group consisting of Peter Kiewit Sons Co., the Morrison-Knudsen Co., the Mid-Valley Utilities Co., and the Coker Construction Co. Seven bids were submitted, with Merritt-Chapman & Scott submitting the high bid of $50,000,000. The low bid was 12 percent above the Bureau of Reclamation's estimate of $25,889,667.

Flaming Gorge will be a thin-arch concrete structure with maximum thickness of 150 ft. Its height of 490 ft will make it the seventh highest concrete dam in the United States. While it will be primarily a river-regulating structure, it will also produce power from three 36,000-kw generators.

Flaming Gorge will be the second largest dam in the Bureau of Reclamation's Upper Colorado River development program. Construction of Glen Canyon Dam is well advanced. Bids for construction of Navajo Dam, the third in the project, have just been opened. Apparent low bidder is a joint venture group composed of the Morrison-Knudsen Co., the Henry J. Kaiser Co., and the F and S Construction Co., of Los Angeles.

## Fort Worth Water Plant Is Placed in Service

The $5,621,000 South Holly Water Plant at Fort Worth, Tex., was formally placed in service at dedication ceremonies held on June 17. The new plant has a normal treatment capacity of 50 mgd and pumping capacity of 135 mgd. Together with the old North Holly Plant, the city water system now has a rated capacity of 129 mgd. Design of the new plant will permit ultimate expansion of the whole system to a capacity of 250 mgd.

Components of the new plant include a 72-in. raw water conduit from the West Fork of the Trinity River; three sedimentation basins with continuous sludge-removing facilities; twelve open filters; an administration building, with filter center and laboratory; two 6,000,000-gal clear wells; and a high-service pump station and appurtenances.

The plant took four years of planning and construction. A series of eleven contracts were let, with actual construction getting under way in 1956. The general contract of $4,091,800 to C. H. Leavell and Co., of El Paso, Tex., is the largest ever let by the City of Fort Worth. The plant was designed by the Fort Worth engineering firm of Freese & Nichols. Uel Stephens, M. ASCE, is director of the Fort Worth Water Department.

## Belgian Transportation Pavilion at Brussels Receives $25,000 AIA Reynolds Memorial Award

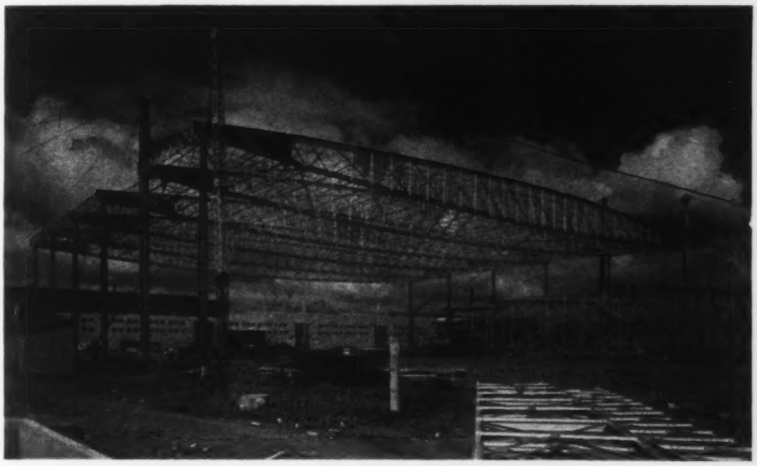
At its Cleveland convention, held in July, the American Institute of Architects honored the architects and the structural engineer of the Transportation Pavilion at the Brussels World's Fair with the second Reynolds Memorial Award. The award is for "the most significant contribution to the use of aluminum, aesthetically and structurally, in the building field."

The Transportation Pavilion is an impressive open structure, 660 ft long by 238 ft wide, with lens-shaped aluminum roof trusses supported on steel columns about 50 ft above ground level and spanning the short dimension of the building. Corrugated aluminum sheets between the roof trusses form the roof and ceiling of the pavilion. Wind loads and thermal expansion are handled by a unique system of high-strength steel wires extending from a point below mid-height of each column to an attachment at the bottom chord of the next adjacent trusses at about the same distance from the column head. The wires are pretensioned and held in permanent tension by springs so that under no condition of wind load will the wires be slack.

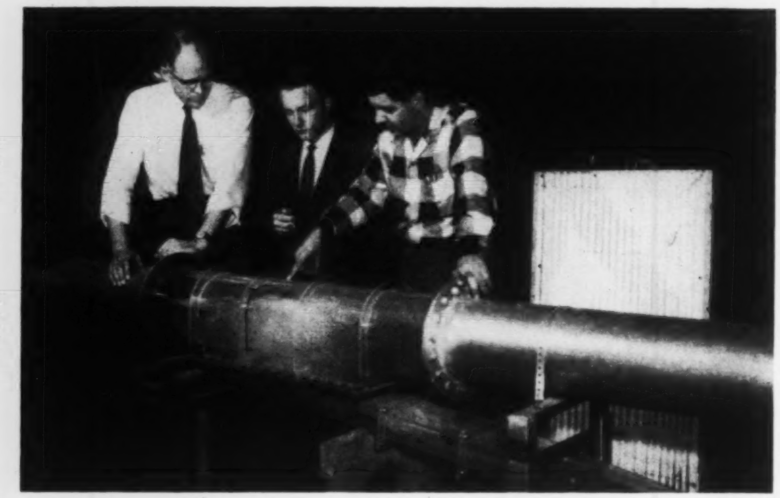
The team of seven sharing the $25,000 award are the Brussels architects T. Courtois, J. Goosens-Bara, F. Hoet-Segers, T. Hoet-Segers, H. Montoies, and R. Moens de Hase, and consulting engineer A. Lipski. The AIA Award Jury that selected the structure was composed of Arthur L. Harmon, chairman; Richard Bennett, J. Roy Carroll, Pier Luigi Nervi, and Richard J. Neutra. In commenting on the structural concept, Mr. Nervi said, "the most remarkable characteristic of the work has been possible only as a result of the original tie-rods in permanent tension which connect posts and trusses."

Mr. Lipski is the author of a comprehensive article about the outstanding structure which is scheduled for publication in October.

**Construction view of impressive Transportation Pavilion at World's Fair is shown below. Building is open structure, 660 ft long by 238 ft wide, with lens-shaped aluminum roof trusses supported on steel columns. Springs (shown in small view) hold the wires controlling wind load and thermal expansion in permanent tension and keep them from becoming slack.**



## *Hydraulic Laboratory Tests Model for Ecuador Plant*



**This small-scale manifold-diffuser is part of a model of a hydroelectric plant bypass tunnel now being tested in the Colorado State University hydraulic laboratory, prior to installation of the unit in a large power plant expansion near Quito, Ecuador. The manifold was designed by Dr. Ray Chamberlain (center), chief of civil engineering research at the university. Computations required in building the model were made by Suleiman Ayoub (right), research assistant from Jordan, under direct supervision of Maurice L. Albertson, M. ASCE (left). Dr. Albertson was the originator of the manifold idea.**

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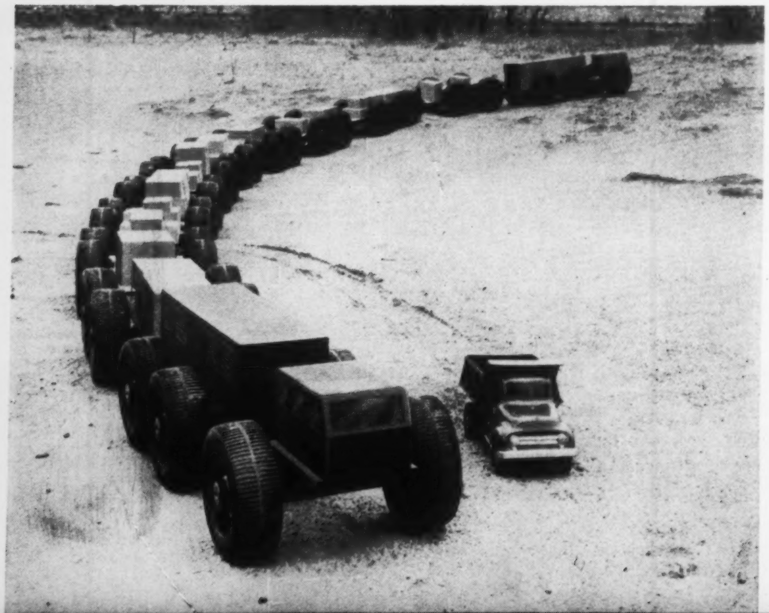
## *Trackless Train Developed for Off-Highway Use*

**A 52-wheel, rubber-tired, cross-country train, suitable for use with either atomic reactors or conventional types of engines, has just come off the design boards at R. G. LeTourneau, Inc., of Longview, Tex. This photo shows an electric model of the trackless train, which has been built and tested. Designed for use in under-developed areas, such as the Sahara or Arctic, the train features all-wheel drive, complete steering controls at both ends, and availability of equal speed and power for travel in either direction. The tires, measuring 10 ft high and 4 ft wide, will be the largest in the world.**



## Bhakra Dam Will Start Storing Water

Better times are in store for the peoples of the drought-stricken desert states of Punjab and Rajasthan in northwest India with the completion this June of the first stage of Bhakra Dam, currently under construction across a narrow gorge of the Sutlej River in East Punjab. Now that the huge concrete gravity dam has reached a height of 408 ft, engineers have decided it is safe for partial storage of flood waters from the monsoon rains that are due between July and September. The surplus from these heavy rains will be stored in the dam and released as needed in the long dry season.

Some 500,000 acres of barren land in two states will be brought under year-round cultivation by completion of the first stage of Bhakra Dam. This is in addition to the 2,000,000 acres already being irrigated by supplies from Nangal Dam—a regulating reservoir about eight miles downstream from the main Bhakra Dam, which was completed three years ago. Before work on either dam was started, a 3,000-mile canal system was completed, which meant that irrigation could begin the moment water storage was possible.

Part of a vast $365,400,000 Bhakra-Nangal multipurpose river valley development, the new dam ultimately will be built to a height of 700 ft. When it is completed, it will impound a reservoir of 7,400,000 acre-ft. Completion of the entire project is expected by March 1960 after ten years under construction.

The Bhakra-Nangal development is being built by the Public Works Department of Punjab State, under the overall supervision of Harvey Slocum, a United States specialist on dam construction. The Designs Directorate, located at New Delhi, prepares the designs and specifications for the project under the direction of C. L. Handa, M. ASCE. The important designs were checked in the United States by the Bureau of Reclamation.

The ultra-modern construction plant required to build Bhakra Dam was described by Mr. Slocum in the August 1956 issue of CIVIL ENGINEERING (pages 44-51.)

## Stone & Webster to Build Power Plant Extension

The Central Illinois Electric and Gas Co. has awarded a contract to the Stone & Webster Engineering Corp., of Boston and New York, for the design and construction of an extension to its power-generating plant in Rockford, Ill. The 50,000-kw plant, designated Unit No. 4 of the Sabrooke Station, is scheduled for completion in 1961. It will cost about $11,000,000. C. G. Davis, M. ASCE, will be construction manager on the project.

## New Housing Starts Rise in May

Non-farm housing starts rose slightly more than seasonally to 105,000 this May, compared with 95,000 in April and 103,000 in May 1957, according to preliminary estimates of the U.S. Labor Department's Bureau of Labor Statistics. The May advance of about 11 percent followed a more than seasonal rise in April. Preliminary tallies of building-permit reports indicate that the gain in housing starts was nationwide, though the gain was less apparent in the South than elsewhere.

Privately owned units started in May totaled 98,000 and accounted for most of the overall increase. Housing begun under FHA and VA programs was responsible for two-thirds of the May rise in private starts, compared with about half the previous month's gain.

On a seasonally adjusted basis, private starts this May were at an annual rate of 1,010,000, marking a return to the better-than-a-million rate prevailing during the latter half of 1957 and in January 1958. The seasonally adjusted annual rate of private starts for the first five months of 1958 averaged 957,000, virtually the same as for the comparable period of 1957.

The 413,000 private and public units begun during the first five months of 1958 almost equaled the final estimate of 413,700 for the same 1957 period. This year's private total (387,000 units) was only a little below the 1957 figure for the first five months, and the 1958 public total (25,300 units) was a little higher.

## Contract Awarded for Oil-Drilling Platforms

A large contract calling for the construction of fifty deep-water concrete drilling platforms in Lake Maracaibo, Venezuela, has been awarded by the Mene Grande Oil Co., a subsidiary of Gulf Oil, to Raymond-Brown & Root—a jointly owned subsidiary of Raymond International Inc., New York, and Brown & Root, Inc., Houston, Tex. Work has already started, and a production schedule of a platform a week is planned.

The new contract will bring to 159 the total number of offshore structures placed in Lake Maracaibo by Raymond-Brown & Root in the past two years. For the deep-water platform work the company uses long prestressed concrete cylinder piles. Pioneered by Raymond, the cylinder pile is particularly suited to work in Lake Maracaibo because it can support heavy loads without expensive lateral bracing and because it does not deteriorate in the highly corrosive lake water.

## *Work on Glen Canyon Dam Is Well Under Way*

**Construction is in full swing at Glen Canyon Dam site on the Upper Colorado River between Arizona and Utah. Shown here is the inlet portal of the left diversion tunnel, looking from the inside to the right canyon wall about 1,000 ft away. This part of the work is being handled by the Frazier-Davis Construction Company by subcontract for Merritt-Chapman & Scott, holder of a $107,155,222 contract for the dam and power plant—the largest single contract ever awarded by the Bureau of Reclamation. The 700-ft-high concrete gravity arch dam will impound a 28,000,000 acre-ft reservoir. A 900,000-kw plant will be located 470 ft downstream from the dam. The huge project is scheduled for completion some six years from now.**

## *Long Beach Bridge—Unit in Southern California Freeways*

**Bridging the gap between the east and west banks of the Los Angeles River Flood Control Channel is Bethlehem Pacific's derrick traveler, at work on the Ninth Street Bridge in Long Beach. When the $8,200,000 project is completed early next year, it will tie the downtown area of the port city into the Long Beach Freeway, relieving present-day street and highway congestion. It is estimated that the eight-lane bridge will initially carry 34,000 vehicles a day, and that this number will double by 1972. Long Beach Harbor engineers planned the bridge and supervised its construction. Moffat and Nichols were the engineers, and the Guy F. Atkinson Company the general contractor.**

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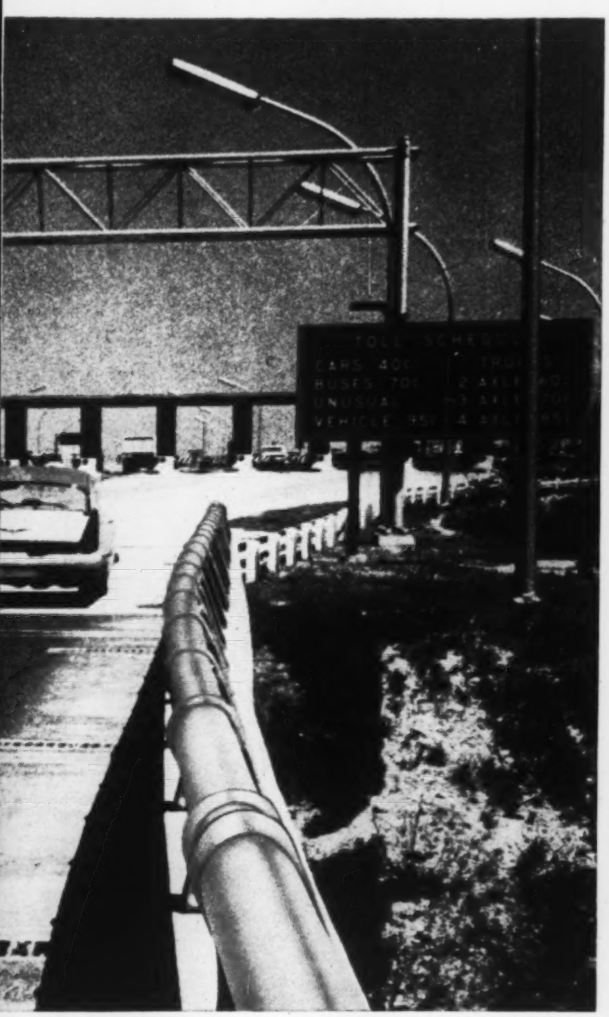

◀ **Baltimore's New Patapsco Harbor Tunnel** is an engineering "first," a twin tube trench project covering 18 miles including approaches. Tunnel runs 6,300 feet under Baltimore Harbor and carries two lanes of traffic in each twin tube.

## Corrosion-resistant Alcoa Aluminum saves money, man-hours on Baltimore's new Harbor Tunnel project

The expense of painting went into the savings column on Baltimore's Patapsco Tunnel—for seven miles of railings made of Alcoa® Aluminum, plus aluminum fencing and overhead sign structures. In the years ahead, there'll be no maintenance because of salt air, industrial fumes or air-borne grit.

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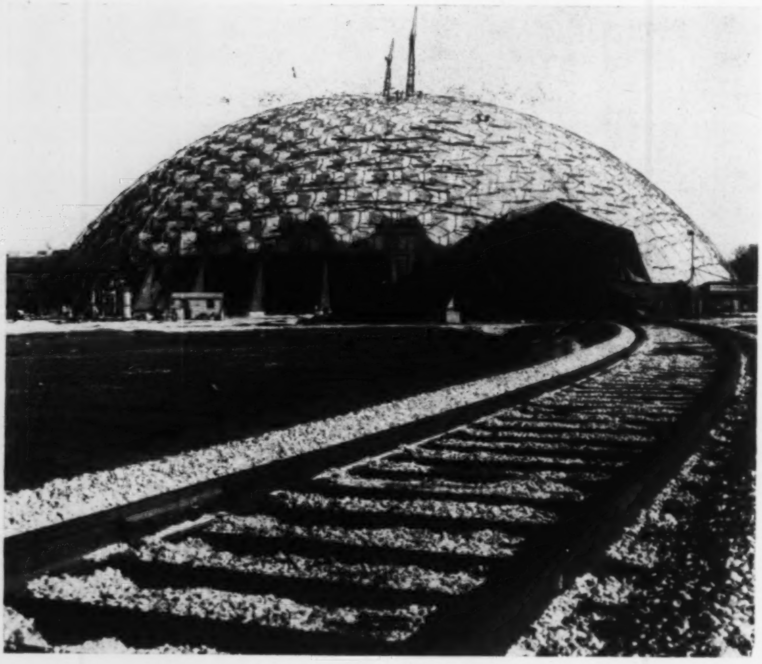
## *Geodesic Dome Used for Tank-Car Repair Shop*



**This geodesic dome, which is being built at Baton Rouge, La., by the Union Tank Car Company, of Chicago, as a modern repair shop and maintenance plant, is the largest dome in the world and the largest circular structure in the world without internal supports. It is 384 ft in dia, 116 ft high at its zenith, and provides a working area of 110,000 sq ft. The Union Dome is the first geodesic dome fabricated entirely of steel. Built without internal supports of any kind, the dome permits bringing cars into the shop in circular layout. Material storage will be in the center, and a transfer table will be operated circularly around it. The outer half of the circle will be devoted to specialized repair installations. The cost of well over $1,000,000 will be considerably less than that of a conventional repair and maintenance shop of similar capacity. Battey & Childs, of Chicago, did the general engineering for the project, and the Nichols Construction Co., of Baton Rouge, is the construction contractor.**

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## Better Technological Education Urged at ASEE Meeting

The threat of Russia's passing us in the technological race through more concentration on education is greater than the immediate danger to our nation from U.S.S.R. space advances, Dr. Simon Rams, a top scientist of the Air Force's large intercontinental ballistic missile and space program, told the American Society for Engineering Education at its recent annual meeting at the University of California at Berkeley in June. Describing the world of the future as a highly technical civilization, he stated that the future resources of a nation will be measured more by its brainpower than by any other resource.

Discussion of the need for more postgraduate study and research dominated the sessions attended by some 1,000 members of the ASEE. The group was told by Dr. Gene M. Nordby, A.M. ASCE, program director for engineering sciences of the National Science Foundation, "that approximately 550 man-years of untapped research talent are presently available in the engineering education ranks. This," he continued, "would require an estimated $10 million per year for full utilization, plus a large investment in capital facilities."

In describing the role played by the government, Dr. Nordby stated that two-thirds of the funds for research in educational institutions is provided by the Federal Government. He stated that there is "a serious lack of support of the more routine type of engineering research . . . such as the study of fatigue of materials and improvement of engineering analysis by adoption of computer methods. The National Science Foundation, Dr. Nordby explained, is prevented from supporting such research because of the narrow interpretation of the enabling legislation.

Dean Harold E. Wessman, M. ASCE, of the College of Engineering at the University of Washington, expressed his belief that if Congress desires to improve the quality of engineering in this country, then emphasis must be placed on graduate-aid programs rather than on undergraduate fellowships.

While speaking about the engineering manpower situation, Dr. Henry H. Armsby, chief of engineering education in the U.S. Department of Health, Education, and Welfare, stated that a survey of 88 college placement officers revealed that 71 percent of the June graduating engineers had either already accepted a job or had jobs that they were seriously considering. The survey, said Dr. Armsby, also showed the fact that an alarmingly small percentage of engineers are planning to continue in postgraduate study. Only nine percent of this year's engineering graduates planned graduate study.

The sessions held by ASEE again indicate the considerable increase in fellowships needed to encourage our brilliant young engineering students to pursue graduate-studies. Moreover a big increase in support for engineering research is urgently needed.

## AIChE Has Golden Jubilee Celebration

The spectacular growth of the chemical industry over the past fifty years and the contributions of the American Institute of Chemical Engineers to the industry during this period were celebrated at the recent Golden Jubilee anniversary of the AIChE, held in Philadelphia the last week in June.

In a featured symposium on "process control," speakers emphasized the need for increased mechanization of processes and extension of automatic control, if the industry is to go forward. Of wide general interest was a symposium on metallic materials of construction. In this program it was noted, "that there is hardly an industry where advanced process and equipment concepts have not outstripped the materials necessary to implement them." The program also underscored the fact that the particularly critical needs of atomic energy processes demand "more basic understanding of the mechanism of material failure." Some of the papers in the symposium dealt with stainless alloys and metallic corrosion.

Recently United Engineering Trustees took action making AIChE one of the Founder Engineering Societies, along with ASCE, ASME, AIEE, and AIME.

(*Continued on page 96*)

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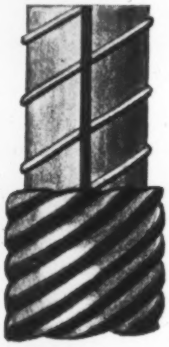

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## NEWS BRIEFS

(*Continued from page 94*)

### Saline Conversion Plant In Operation in Aruba

Start of production of the world's largest single installation to convert sea water to fresh water is announced by the Government of the Island Territory of Aruba, Netherlands Antilles. The unit is said to be the first to combine salt-water distillation with the production of marketable surplus electricity, resulting in lowered costs. The $10,000,000 plant will provide 2,700,000 gpd—enough for the entire 70-sq mile Caribbean island with its population of 55,000, and its major industry, the American-owned Lago Oil & Transport Company refinery.

Lowered water costs are expected to result from the use of steam-electric plant in conjunction with the distillation units. As in conventional power plants, most of the steam generated in the high-pressure boilers can be sold. The exhaust steam, however, will be used to distill the sea water. The maximum output of the Aruba generating plant is 15,000 kw.

The plant was designed and built by Singmaster & Breyer, New York engineers affiliated with the Fluor Corporation, Ltd., of Los Angeles.

## N*G*Neare's COLUMN

R. ROBINSON ROWE, M. ASCE

It was a hot night in Esseyeville, and only half a crowd attended the regular August meeting of the Engineers Club. The Juniors were in the field on construction; their seniors in the mountains on vacation. But Cal Klater was there, and so was Joe Kerr.

"Professor Neare must be on vacation, too," guessed Joe. "Let's go home."

"No you don't," ordered Cal. "I'm Acting Professor while he's on business in Milwaukee. Let me read you a letter he sent me:

*Milwaukee, Wis.*
*August 2, 1958*

*Dear Cal:*

*I won't be back in time for the next meeting, so will you act for me? The last problem wasn't difficult and Joe probably has the answer, or thinks he has. If he hasn't, help him.*

*In Portland last June, I watched a local engineer mow his back yard, cutting the first swath around the perimeter and continuing around the uncut perimeter spiral fashion. The yard was pentagonal with equal angles at the first and third corners and also at the second and fourth. His third swath eliminated the fifth side, leaving an uncut quadrilateral with an area of 360 sq ft. His sixth swath eliminated the third side, leaving a triangle of 96 sq ft. The 9th swath finished the job. If the area of the yard was 756 sq ft, what was its perimeter?*

*Unless you can think of a better problem, that's the new assignment. See you in September. Cheerio,*

*Noah*

"So, Mr. Kerr, I'm the Professor tonite. Do you have the answer to last month's easy problem, or do you need help?"

"My dear Professor Klater," smirked Joe, "I have and I don't, exclamation point. The problem was to set up in cipher the multiplication of two numbers so that the product would be 8255590, this number being the amount in cents of the Voluntary Fund last March. Altho it looks trivial, the simplest factor is 10, for which I have devised this cipher:

$$\begin{array}{rcr} 825559 & \qquad & \text{KERRRU} \\ 10 & & \text{AM} \\ \hline 8255590 & & \text{KERRRUM} \end{array} \quad \text{QED.''}$$

"My dear Joseph, you have flunked again. The cipher must have only the one solution, but, while AM is uniquely 10, the KERRRU has many possibilities, such as 389992. The lesser factors of 8255590 are 1, 2, 5, 7, 10, 14, 35 and 70. Unique ciphers can be made for 7, 14, 35 and 70; for 14 I have

$$\begin{array}{rcr} 589685 & \qquad & \text{STUNTS} \\ 14 & & \text{AL} \\ \hline 8255590 & & \text{TOSSSUP} \end{array}$$

which is unique without showing the intermediate steps of the multiplication. I suspect, without checking, that the same is true for the factor 35, for which I have two ciphers,

$$\begin{array}{rcrcr} 235874 & \quad & \text{RYE TOP} & \quad & \text{OUS TED} \\ 35 & & \text{YE} & & \text{US} \\ \hline 8255590 & & \text{TREE ELF} & & \text{TOSS SAM} \end{array}$$

See what I mean, Mr. Kerr?"

"I can put it this way,

$$\begin{array}{r} \text{EASY DO} \\ \text{AS} \\ \hline \text{YESSSIR.''} \end{array}$$

[*Cal Klaters were S·K Rueball (Keith Jones), T. R. Anand, Francis Finch and Ed C. Holt Jr. Also acknowledged are solutions to the May problem on staffing a highway department from Warner Harwood, George N. Hyland, and C. W. Trigg.*]

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# DECEASED

**Harry K. Carpenter** (A.M. '17), age 71, chief engineer for the Rolland Glass Company in Clarksburg, W. Va., died there on May 13. Mr. Carpenter, who studied at Ohio Northern University, began his engineering career with the Bridge Division of the City of Pittsburgh where he assisted in the design of the North Side Point Bridge and various other structures. Later Mr. Carpenter was chief engineer for the Concrete Steel Bridge Company in Clarksburg.

**Daniel W. Cole** (M. '05), age 95, former New York city consultant and construction engineer, died at his home in Marietta, Ga., on June 2. Mr. Cole was active on the engineering staff of Ebasco Services, Inc., in New York from 1923 until 1939 when he returned to his home in Georgia. In his connection with Ebasco, he had a part in the construction of over 300 dams throughout the world. Two of these structures—Shoshone, Wyo., and Arrow Rock, Idaho—were the highest in the world when they were designed. After his retirement from the Ebasco staff in 1946, Mr. Cole continued to serve as a consultant with the firm until his death.

**Robert F. Blanks** (M. '40), age 57, vice president and general manager of Great Western Aggregates, Inc., Denver, Colo., died there on July 14. A graduate of Kansas State College, Mr. Blanks held administrative positions in Idaho public schools. For 20 years, he was with the Bureau of Reclamation in Denver, finally serving as chief of all the Bureau's research work. While in charge of special studies of the Hoover Dam and the power plant for the Bureau, he established two large laboratories and the standardization of equipment and procedures. Mr. Blanks was author of many technical papers and of special engineering reports, and in 1947, was winner of the Society's Thomas Fitch Rowland Prize. Mr. Blanks served as chairman of the Reinforced Concrete Research Council. For the past seven years he had been with Great Western Aggregates, Inc.

R. F. Blanks

**Horace H. Esselstyn** (M. '08), age 83, retired consultant of Detroit, Mich., died there recently. Educated at Cooper Union and Columbia University, Mr. Esselstyn in his early career was an expert in railway electrification. In 1909 he went to Detroit as resident engineer on all powerhouse and other work for the Detroit Edison Company. In 1916 he opened his own office in Detroit as engineer and architect, working on the design and construction of large industrial plants, power plants, automobile plants, and bridges. He was engineer on the $3,000,000 Belle Isle Bridge and one of the subcontractors on the foundations of the Ambassador Bridge across the Detroit River.

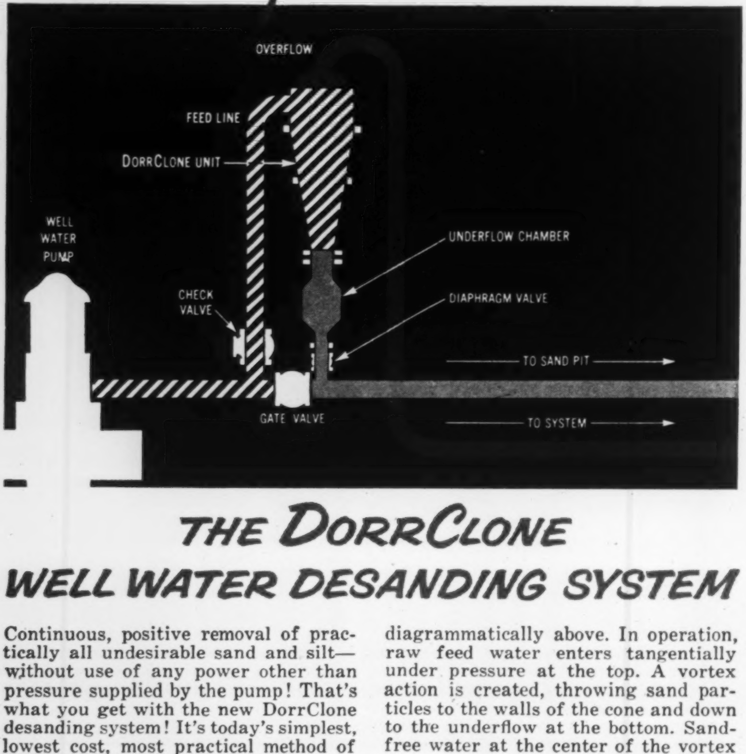
**Halbert Gillette** (M. '04), age 88, president of the Gillette Publishing Company, died at his home in San Marino, Calif., on June 18. Mr. Gillette was the founder and head for more than fifty years of the publishing company bearing his name. The firm publishes *Roads and Streets* and other construction field publications. Mr. Gillette was author of several books on construction methods and costs.

**Charles O. Gunther** (M. '25), age 79, ballistics expert and professor emeritus of mathematics and ordnance engineering at Stevens Institute of Technology, died in Short Hills, N. J., on June 8. Dr. Gunther was graduated from Stevens and received an honorary doctorate of engineering from his alma mater. He investigated the identification of firearms and bullets under an Engineering Foundations grant. He wrote several books on ballistics. A long-time faculty member of Stevens, Dr. Gunther retired in 1952.

**Louis M. Hachenberg** (A.M. '23), age 69, manufacturer's representative for Hallikainen Instruments in Wood Ridge, N. J., died there on February 13. Mr. Hachenberg had spent his career in metropolitan New York and New Jersey. For many years he served the C. J. Tagliabue

(*Continued on page 100*)

IT'S NEW / It's from DORR-OLIVER



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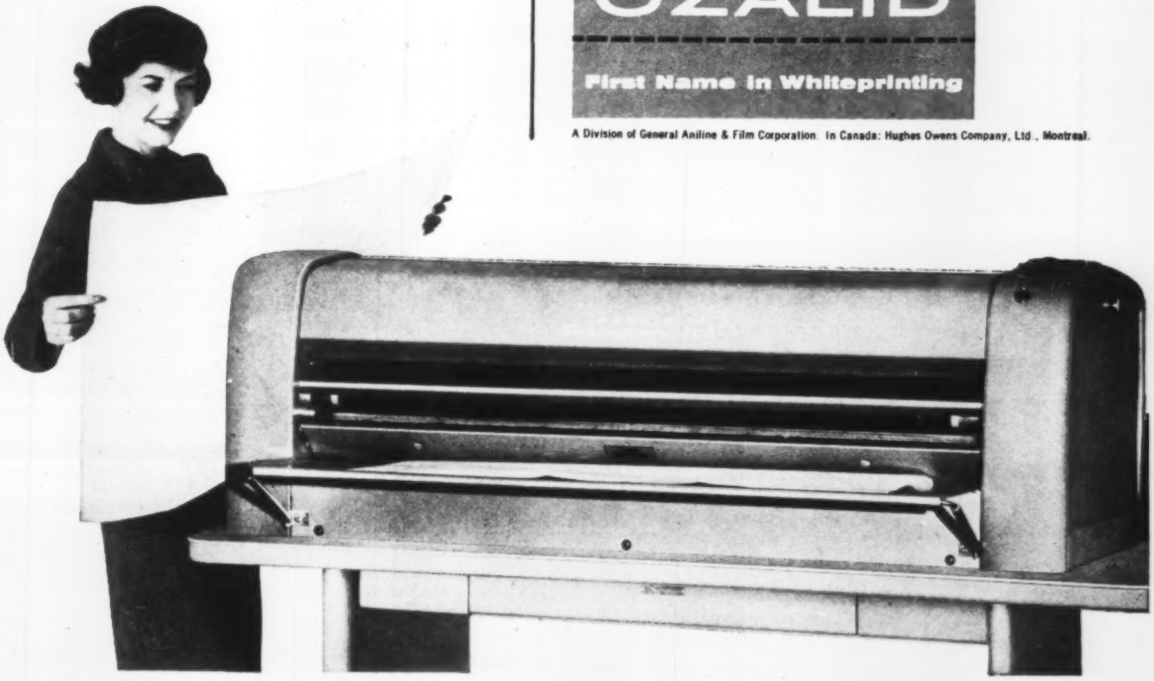

## DECEASED

(*Continued from page 98*)

Manufacturing Company as sales engineer, then as district manager for the metropolitan area.

**Frederick M. Hart** (A.M. '23), age 76, assistant chief of the Special Maps Project Section, Topographical Division of the U. S. Geological Survey, Washington, D. C., died in Silver Spring, Md., on June 27. Dr. Hart was graduated from Columbian College Medical School as a doctor of medicine, but soon after graduation turned to engineering and map work with the Geological Survey. In his 48 years as a cartographer with the Survey, he had held many responsible positions.

**Seth G. Hess** (M. '30), age 65, director and chief engineer of the Interstate Sanitation Commission, New York City, died there on June 19. Mr. Hess was graduated from Cornell University with a degree in civil engineering. A veteran of World War I, he had been active on numerous projects involving studies, designs and supervision of water works and sewerage systems in the United States and abroad. He joined the Interstate Sanitation Commission in 1937 as chief engineer and became director in 1943. Mr. Hess served on the faculty of the Graduate School of New York University.

**S. G. Hess**

**Nelson J. Lomax** (A.M. '19), age 69, retired engineer of Long Beach, Calif., died there on April 30. A graduate of the Sheffield School of Science at Yale University, Mr. Lomax spent much of his career in various phases of railway work. He was with the Missouri Pacific Railway as a resident engineer and later with the Union Pacific Railway as bridge designer. For several years he was affiliated with the National Engineering Company in Chicago.

**Daniel F. MacNamee** (M. '47), age 60, president of the Daniel F. MacNamee Company, Inc., of New Rochelle, N. Y., died there on June 14. Mr. MacNamee had been resident engineer for Fuller and McClintock and was engaged for several years on the design and construction of sewerage systems in the metropolitan New York area. Since 1929, Mr. MacNamee had been president of his own company. He was a graduate of Lafayette College.

**Leon W. Mashburn** (M. '20), age 76, retired engineer of Clarksdale, Miss., died there on June 15. Mr. Mashburn studied at the University of Tennessee. For many

(*Continued on page 102*)

which one
is right?

no question . . .

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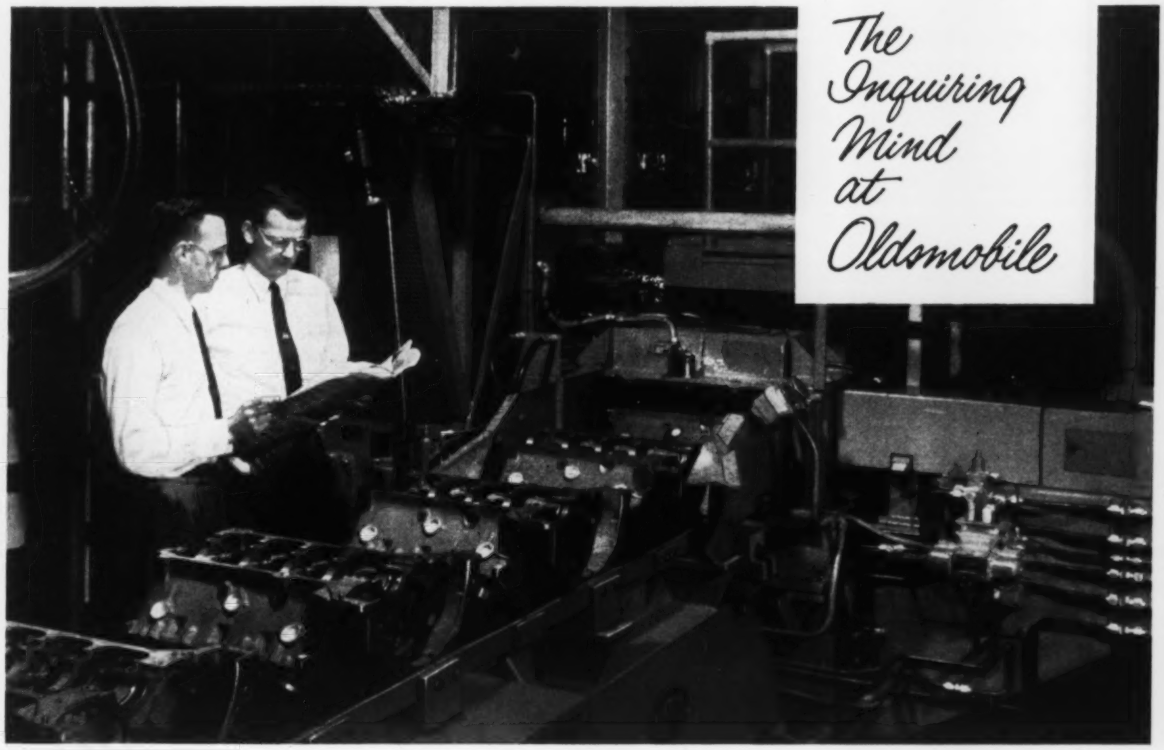

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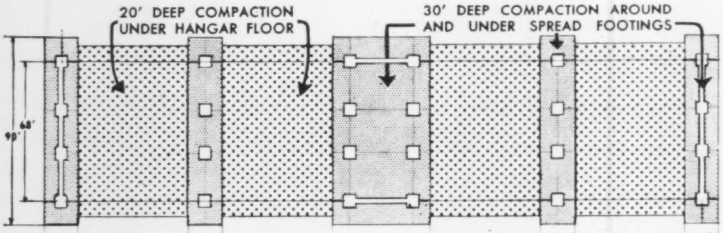
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52'
16'
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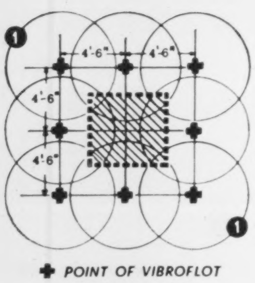

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## DECEASED

(*Continued from page 100*)

years he was chief engineer and owner of the Southern Engineering Company in Clarksdale. At one time he was with the Reconstruction Finance Corporation as an appraiser.

**George A. McKay** (M. '09), age 84, retired Captain in the Navy Civil Engineer Corps, died in Key West, Fla., on June 12. Captain McKay was a graduate of Rensselaer Polytechnic Institute. He enlisted in the Corps of Engineers in 1902. He had supervised Naval construction in Samoa and Pearl Harbor, and was in charge of the construction of the Naval Training Center at Great Lakes, Ill. He had been public works officer at San Diego and Assistant Chief of the Bureau of Yards and Docks in Washington, D. C.

**Robert W. Strong** (A.M. '54), age 38, vice president of Thomas B. Bourne Associates, Inc., engineers and architects of Washington, D. C., died in Alexandria, Va., on May 1. A graduate of the University of New Mexico, Mr. Strong spent several years with the New Mexico State Highway Department as junior bridge designer.

**Michael T. Walsh** (A.M. '26), age 70, engineer of Niagara Falls, N. Y., died there on October 6, 1956. A graduate of Cooper Union, Mr. Walsh had practiced engineering in New York for several years. With the Plymouth Cordage Company, Mr. Walsh served in Cuba as manager of a sisal plantation of which he later became owner. In 1941, Mr. Walsh moved to Niagara Falls where he was with the Carborundum Company and the Great Lakes Carbon Company.

## Positions Announced

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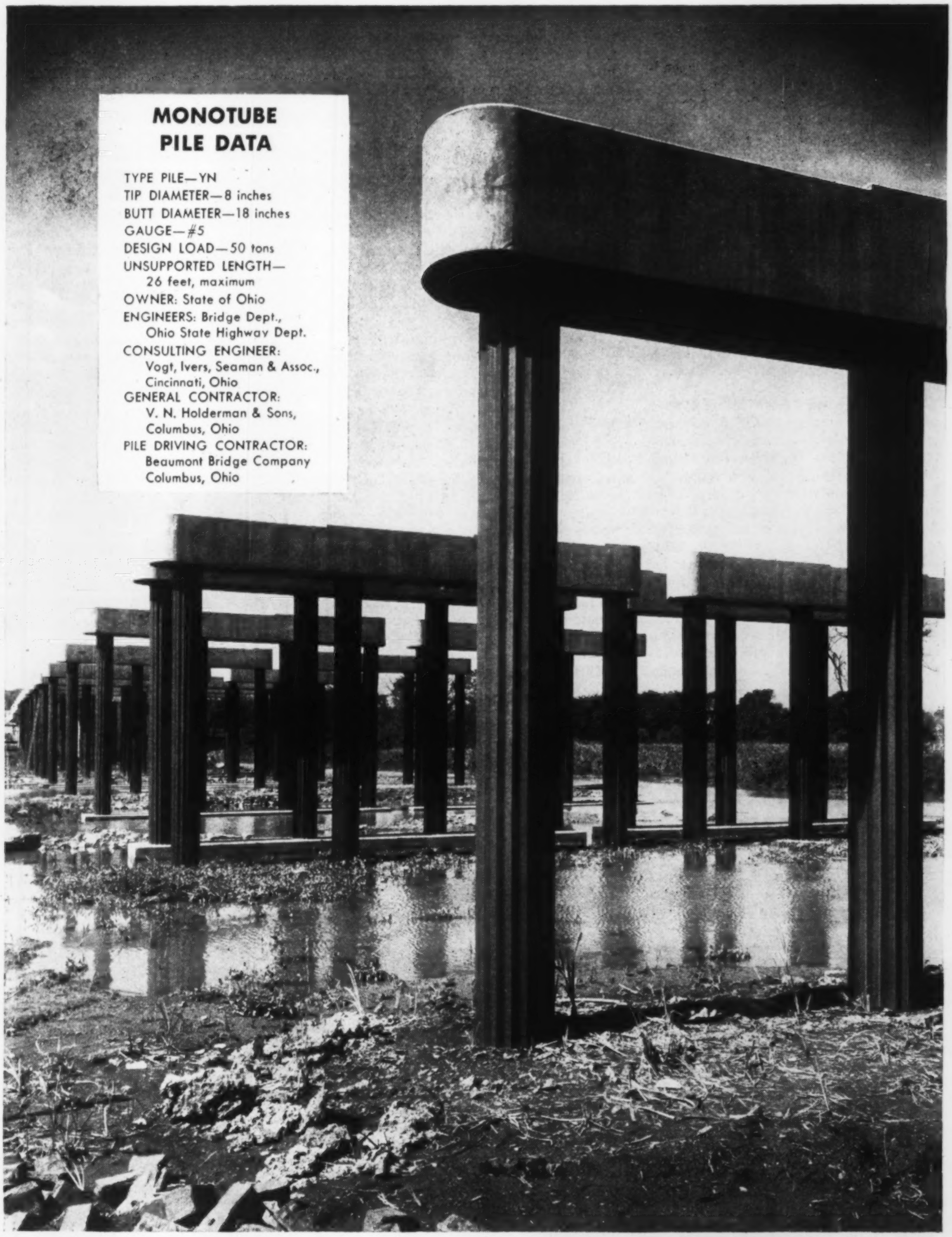
## New in Education

**Engineering schools are adding** more courses to the summer schedules being offered to engineers who have the time, interest, and energy to get out of their cool hammocks and return to hot classrooms. *The University of Southern California* is making an effort to educate our scientific and technological personnel in ways and means of studying advances made by the Russians. The Extension is offering a course in Scientific Russian in a group of language courses planned for evening study at UCLA. The course will be a functional approach to the study of Russian designed to teach specialists to read and understand Russian scientific and technical material. Information is available from University Extension, UCLA, Los Angeles, Calif.

**Big Business is continuing to spend** big money on education. The U. S. Steel Foundation, Inc., announces a grant of $2,000,000 to 655 American privately supported liberal arts and engineering colleges. *Massachusetts Institute of Technology* and *California Institute of Technology* are among the engineering schools receiving generous portions of the grant. *Lafayette College* is the recipient of a total of $10,000 for masonry cement research. Alpha Portland Cement Co., donor of the grant, gave half the sum last year and has recently contributed the additional $5,000 which will make possible field testing as part of this research project.

**Institutions of engineering learning** all over the country are refurbishing their engineering curricula to meet the changing requirements of the profession. The *University of Michigan* believes that the cultural background of a civil engineer has great influence on the quality of his work. To prove this hypothesis, the university's engineering and literary colleges are offering a five-year combined program leading to the degrees of Bachelor of Arts and Bachelor of Science in Civil Engineering. Students enrolling in this program must take four semesters in the literary college and six semesters and a summer school session in the engineering college. At *Case Institute of Technology*, the engineering student will be introduced to practical engineering early in his education. The new plan there will cut semester credit hours from 157 to 145, freeing students for independent study. The entire program is geared to meet modern engineering needs and to encourage students to do independent research. Engineering education at *Swarthmore College* will get a new look as the honors program is introduced into the engineering department. The program will cut across traditional departmental divisions and emphasize basic scientific disciplines rather than specialized technical subjects. As part of the honors program,

(*Continued on page 106*)



**MONOTUBE PILE DATA**

TYPE PILE—YN
TIP DIAMETER—8 inches
BUTT DIAMETER—18 inches
GAUGE—#5
DESIGN LOAD—50 tons
UNSUPPORTED LENGTH—
26 feet, maximum
OWNER: State of Ohio
ENGINEERS: Bridge Dept.,
Ohio State Highway Dept.
CONSULTING ENGINEER:
Vogt, Ivers, Seaman & Assoc.,
Cincinnati, Ohio
GENERAL CONTRACTOR:
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## NEW IN EDUCATION

(*Continued from page 104*)

students with the capacity for independent work will meet in seminar sessions. To add impetus to scientific development in the Middle West, 26 educational and research institutions have formed an inter-university corporation, known as *Associated Midwest Universities.* Headquarters for AMU will be at Argonne National Laboratory's main site near Lemont, Ill. The three main purposes of AMU are to promote, encourage, and conduct research and education in all branches of science; facilitate the use of Argonne National Laboratory and other laboratories by personnel from the cooperating universities; and to establish and maintain other such facilities as are necessary for research and education.

**The spring showers have brought** up a new crop of buildings for engineering schools in various sections of the country. In April the *Brooklyn Polytechnic Institute* dedicated its new home in Brooklyn. In the best naval tradition, the christening of the new building had Rear Admiral H. G. Rickover as speaker. A total of $18,000,000 in new construction is planned at *Tulane University* in the next decade through a $96,000,000 fund-raising program for the university's further development as a center of teaching and research. A $10,000,000 science building is on the list of new projects. *Swarthmore College* will have a new science building to be constructed with an $1.8 million grant made to the school last year from Longwood Foundation, a non-profit corporation endowed by the late Pierre S. duPont. Construction plans for a $2,000,000 engineering and technology building at *New York University's* Bronx campus are under way. Financed by a gift from the late Frank Jay Gould, the building is expected to be completed by the spring or early summer of 1960. *Carnegie Institute of Technology* is housing its graduate students in a new graduate dormitory. Slide rules and T squares will be housed in one of Pittsburgh's most distinguished houses, bequeathed to the school by Mrs. Pauline Seeley Mudge.

**To aid and encourage** both undergraduate and postgraduate engineering study, the strain on students' pocketbooks is being eased by a number of scholarships. *The National Science Foundation* has announced the establishment of 85 in-service institutes for high-school teachers of science and mathematics. The institutes will function during the academic year, 1958-1959, and will be conducted outside regular school hours to enable more teachers to attend. Inquiries and applications for participation should be addressed to the Foundation, Washington 25, D. C. Two Denver consultants have added $20,000 to a scholarship fund designated to broaden the education of engineering students at the *University of Colorado.* This latest contribution is an addition to the $30,000 established by R. J. Tipton and Olin Kalmbach, of Tipton Associated Engineers, Inc. The original fund was to enable outstanding engineering students at the University to take an extra year of non-technical study. The *Freeman Fund Committee* in Boston, Mass., is receiving applications for a scholarship covering a program of study or research for one or two years in the field of hydraulics or an allied science. The total grant is the equivalent of $4,000 to a single man and $5,000 for a married one. To be eligible, applicant must be a U. S. citizen, at least 24 years of age, and a graduate of a recognized technical school. Applications should be accompanied by a photograph and not less than five letters of reference. Send applications to the Freeman Fund Committee, c/o Boston Society of Civil Engineers, 20 Pemberton Square, Boston 8, Mass. *The National Science Foundation* announces that it will award approximately 100 senior post-doctoral fellowships on December 5 of this year. These fellowships will go to individuals planning additional study or research. They are available to any U. S. citizen who has demonstrated ability and aptitude for advanced training; who, relative to age, experience, and opportunities has achieved stature as a scientist; and who, prior to October 15, has held a doctoral degree in one of the basic fields of science for at least five years. Applications may be obtained from the Division of Scientific Personnel and Education, National Science Foundation, Washington 25, D. C.

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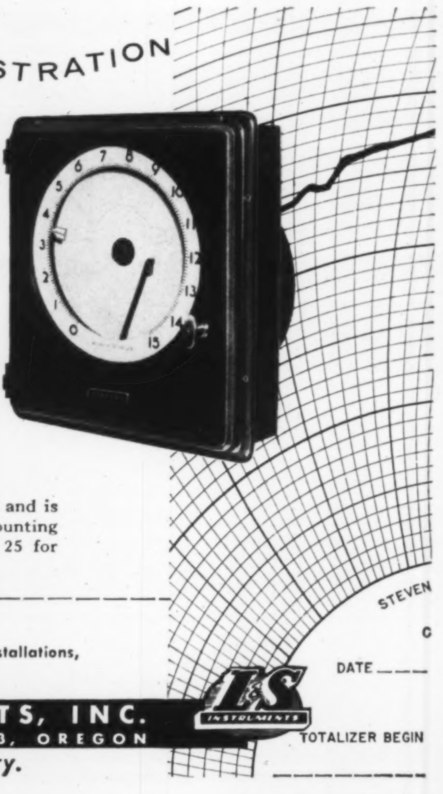

Recording, indicating and totalizing meter for measuring sewage or other flows over Parshall flumes and weirs. This instrument has interchangeable flow cams and flow conversion gears . . . an important factor to consider for sewage treatment plants in rapidly growing communities. With a simple change of cams and gears the Type B-FT Recorder can operate with a different size flume or accommodate a greater range of flow than that for which it was originally purchased. The change does not require factory service. Similarly, change from weekly to daily time scale, or vice versa, is accomplished by merely repositioning one gear — no new parts to buy.

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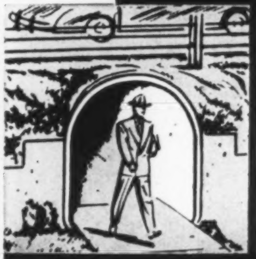

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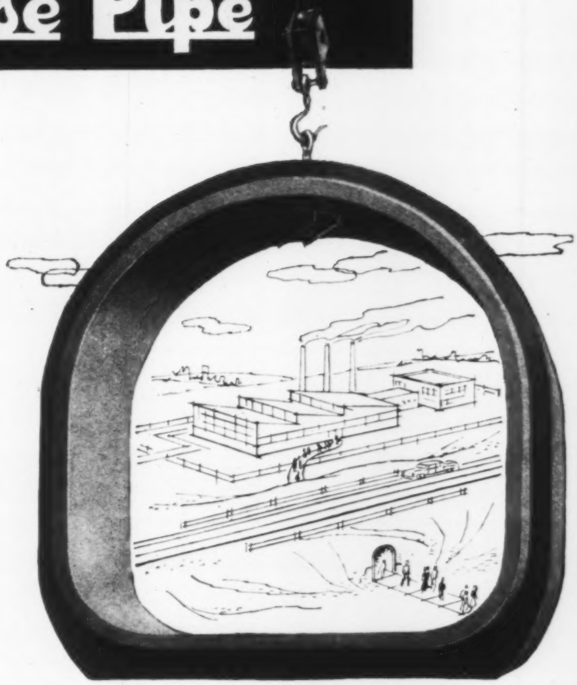
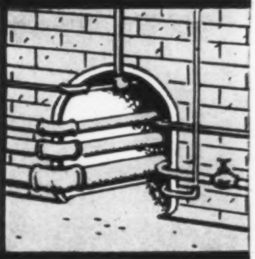
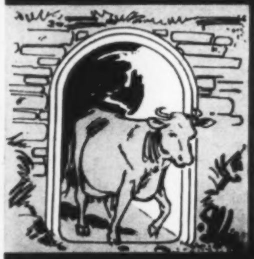
The practical way to safeguard the lives of adults and children. Especially valuable near schools and playgrounds. Also helps to maintain an even flow of street-level traffic.





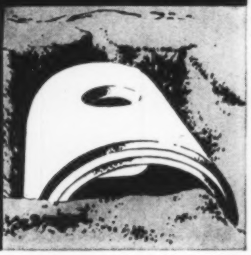
**UTILITY GALLERY**

Carries steam pipes, gas mains, electrical cables and telephone lines with ample room for workmen to make repairs. Flat-Base Pipe is also used for culverts and cattle passes.



**CATTLE PASS**

Eliminate the hazards of road level crossings to lives and livestock with Flat-Base underpasses. Reinforced concrete Flat-Base Pipe can be jacked under railroads and highways without disturbing traffic.



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Manholes for utility companies have often been built with Flat-Base Pipe in less than four hours. This eliminates needless traffic delay and reduces labor costs to a minimum.

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## Men Available

Management, M. ASCE, B.S., M.S. in C.E., 48. Over 25 years' service in Corps of Engineers, U.S. Army involving full responsibility for engineering reports, design, construction of airfields, air depots, hospitals, barracks, breakwaters, dams, harbors as district engineer and contracting officer; also staff and troop command assignments in construction, logistics and training. Will relocate in U.S. or Overseas. C-361.

Designing And Management, M. ASCE, C.E. and Architecture, 52; from 1927 to 1935 chief engineer and architect of real estate company (land development), 1935 to 1952 consulting engineer and architect to several companies. Preferably near New York but would go anywhere. C-362.

Civil And Sanitary Engineer, A.M. ASCE, 35, B.S.C.E., M.S.S.E., registered P.E., Spanish descent; now employed in responsible position and A & E firm; nine years' comprehensive and progressive experience in teaching, design, research and consulting in Civil, Sanitary and POL Engineering. U.S. and overseas experience. Available for responsible position with A & E, consulting or construction firm. Location, overseas, preferably Latin America. Available September 15, 1958. C-363.

Civil Engineer, B.S.C.E., 40, A.M. ASCE, registered professional engineer, 20 years' in heavy construction, surveying, inspection and three years' in structural design, desires position as project manager, superintendent or resident engineer. C-364-891-Chicago.

Civil Engineer, J.M. ASCE, M.S.C.E., 28, South African. Four years' in consultants' offices. Resident engineer—one year. Design experience in structural steel, reinforced concrete, municipal water and sewage schemes, railways and highways. Desires overseas position with consultant, construction or oil industry. Speak Flemish and Dutch. C-366.

Field Engineer, J.M. ASCE, B.S.C.E., 24. 1957 to date: Instrumentman for railroad company. Chief of party, field contact man, draftsman, computer, estimator. 1952 to 1957: Surveyor for engineer. Consulting and surveying; general surveying; sewer, waterworks, and pool design; survey calculating; general estimating. Location desired, West or Southwest. C-367-9805-Detroit.

Chief Engineer-Estimator, M. ASCE, Master of Engineering, 50. 30 years' administrator, supervisor and operating; office, field and management experience, U.S. plus overseas liaison with engineering builders, contractors, designers and consultants. Heavy industrial, public works, private construction; docks, dams, tunnels, foundations, poured prestressed concrete, welded steel. Licensed California, New York and United Kingdom. Location desired, San Francisco Bay Area. S-1519.

## Positions Available

Instructor in Structural Design, civil or architectural engineer or Bachelor of Science, to teach structural design and related subjects in architectural school. Should have strong interest in architecture, a professional license and several years' experience in the design or construction of buildings. Can continue private engineering practice. Location, New York area. W6161.

Superintendent, 28-32, degree in civil engineering or architecture, with strong construction experience, preferably involving multi-story reinforced concrete frames. Outstanding management ability and potential. Position involves complete general contract responsibility at the site of the work for construction of a multi-story reinforced concrete frame apartment building, including layout and supervision of sub-contract trades. Apply by letter giving complete details including salary requirements. Location, northern New Jersey. W6174.

District Sales Representative for manufacturer of heavy construction and mining equipment. Must be experienced in application of excavating and loading equipment. Sales experience desirable. Headquarters, New York, N. Y. W6179.

Teaching Personnel for Department of Civil Engineering, post-graduate training preferably at the Ph.D. level and some design experience. Will teach in the fields of fluid mechanics, soil mechanics and general engineering. Rank and salary commensurate with qualifications. Location, Pacific Northwest. W6225.

Sanitary Engineers, graduates, to deal with sanitary engineering, public health and sanitation, problems such as water systems, their design, construction and operation, chemical and bacteriological analyses; design and construction of sewage treatment plants, soil conditions relating to septic tanks and sewage disposal; other health aspects of housing environment. Must have ability to direct and coordinate professional engineering problems in connection with technical research, design, development, planning or comparable functions. Salaries, $8,645 a year. Locations, Milwaukee, Chicago and Minneapolis. W6238.

Job Engineer-Contractor, Underground, C.E., young, recent graduate or a little experienced. Will work on pipelines, subdivision services (sewer, water, gas, telephone) start in office and then work in field for an established contractor; good break-in opportunity for a young civil engineer. Salary, about $5,100 a year for recent graduate and more for a year or so of experience. Location, San Joaquin Valley, California. S-3653.

Associate Professor, Assistant Professor Or Instructor to teach highways, highway materials and other civil engineering subjects. M.S. or Ph.D. preferred but B.S. degree considered. Rank and salary dependent upon qualifications. Appointment available immediately, or September, 1958 or January, 1959. Location, Midwest. W6256.

Engineers. (*a*) Programming Engineer, graduate civil or architectural, with at least three years' experience in programming U.S.A.F. installations. Salary, $12,000 a year. (*b*) Survey Engineer,

(*Continued on page 109*)

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IMMEDIATE openings in Olympia for graduate civil engineers to do bridge design work in connection with the Interstate System, the Seattle freeway and other highway projects. Five step automatic wage increase schedule. Good promotional opportunity in growing organization. Tenure assured after probationary period in progressive, non-political merit system. Twelve days annual leave per year plus twelve days sick leave allowed per year. Covered by both a state retirement system and U.S. Social Security. Write for application blank to Personnel Division, Washington State Department of Highways, Transportation Building, Olympia, Washington.

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## ESPS

(*Continued from page 108*)

B.S.C.E., with five years' as chief of party on field surveys. Salary, $10,800 a year. (*c*) Structural Engineer, civil graduate, with a minimum of eight years' experience on the design of structural steel and concrete. Salary, $12,000 a year. (*d*) Draftsman, electrical and mechanical, with ten years' minimum experience. Salary, $10,800 a year. Location, North Africa. F6264.

**Resident Engineer**, graduate or registered civil engineer with a thorough practical knowledge of breakwater, jetty and pier construction and both hydrographic and topographic surveys to supervise construction of a small shallow water port. Salary, $12,000 a year, plus travel and expenses. Location, West Africa. F6280.

**Chief Engineer**, 35-50, mechanical or civil graduate, to remodel several industrial plants, to complete the designs from sketches and supervise the construction. Salary, $9,000-$12,000 a year. Location, northwestern Pennsylvania. W6296.

**Field Engineer**, 28-32, graduate civil or architectural, with structural design and field experience. P.E. license desirable. Must be qualified to understand problems of design in structural steel; be interested in promotional work and able to present subject well. Salary, $6,500-$7,500 a year plus fringe benefits. Company will negotiate placement fee; will pay relocation expenses. Location, Philadelphia, Pennsylvania, with traveling in Pennsylvania, Maryland and Delaware. W6307.

**Highway Engineer**. (*a*) Senior Highway and Bridge Design Engineers, civil graduate, with at least ten years' experience. Salary, $12,000-$15,000 a year. (*b*) Supervisory Construction Engineer, with at least ten years' field and office experience on highway and bridge work. (*c*) Solid and Material Engineer with at least five years' supervisory laboratory and specification experience. Salary, $15,000 a year. Applicants must know Spanish. Location, Central America. F6310.

**Structural Engineer** with five to ten years' experience, who can prepare framing plans for building construction and concrete design, for a firm of architects. Salary open. Location, Connecticut. W6334.

SANITARY ENGINEER

Training and experience in Public Health and/or Public Works; willing to undertake training for assignment in an international malaria program. Knowledge of Spanish or French required. Attractive salary and allowances.

*For further details write to* Personnel Officer, *PASB/WHO, 1501 New Hampshire Avenue, N.W., Washington 6, D. C.*

**Soils Engineer**, graduate, 25-45, with two or more years' experience in field soils data making final soils analysis and recommendations. A knowledge of soils mechanics and preferably geology. Duties will include interpretation of field soils data, writing finished soils reports and recommendations, about half-time field supervisor of soil testing operations, compaction control. Some test of concrete and asphalt involved, travel paid, no car required, for a soils laboratory. Salary $6,000-$9,000 a year. Employer will negotiate placement fee. Location, Mississippi. C6903.

**Hydraulic Engineer**, graduate civil engineer, 30-40, with five or more years' experience in hydraulic engineering. Duties will involve preparation of technical literature promoting the use of concrete in dams, flood control structures, culverts and allied fields. Will contact state and federal agencies. Salary open. Employer will pay placement fee. Headquarters, Chicago, with some travel. C6905.

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## RECENT BOOKS

*(added to the Engineering Societies Library)*

### Applied Mathematics For Engineers And Physicists

Second Edition

Louis A. Pipes covers a wide range of topics in advanced fields of calculus. The chapters on matrix algebra, Fourier methods, variational methods, Laplace transforms, and nonlinear differential equations have been considerably expanded in this edition. A new section on Cartesian tensors has been added to the chapter on vector analysis. New illustrations have been added, and the number of problems doubled. (1958, McGraw-Hill Book Company, 330 West 42nd Street, New York 36, N. Y. 723 pp., $8.75.)

### Bibliographic Survey Of Corrosion, 1954-1955

The survey thoroughly reviews corrosion literature for the period covered. Substantial abstracts of papers cited are arranged in eight major divisions: general, testing, characteristic corrosion phenomena, corrosive environments, preventive measures, materials of construction, equipment, and industries. Author and subject indexes are included. (Published by the National Association of Corrosion Engineers, 1061 M & M Building, Houston 2, Texas. 468 pp., $20.00.)

### Castilla's Spanish And English Technical Dictionary

Volume 1: English-Spanish; Volume 2: Spanish-English

This extensive dictionary is primarily concerned with the fields of engineering technology, although commercial and legal terms are included as are words of importance in everyday language because of the continual use they receive. Abbreviations and commercial terms are also included, while those used only in the pure sciences are in general excluded. (Published 1958 by the Philosophical Library, Inc., 15 East 40th Street, New York 16, N. Y. $45.00.)

### Cement And Concrete

Special Technical Publication No. 205

These eight papers deal with various phases of the subject, such as hydrophobic cement and the effect of aggregates on the resistance of concrete to abrasion. (Published 1958 by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa. 152 pp., $4.00.)

(*Continued on page 110*)

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## RECENT BOOKS

(*Continued from page 109*)

### Concrete Technology

Volume I: Properties of Materials

In this volume D. F. Orchard deals with the following aspects: kinds of cement and their properties; additives; concrete aggregates; lightweight concrete; concrete mix design and quality control; properties of cements and concrete; deterioration of concrete and its resistance to chemical attack. (1958, Contractor's Record, Ltd., London, England. 348 pp., 45s.)

### Corrosion, A Symposium

This includes thirty papers from a symposium held at the University of Melbourne in 1955. Papers in the first section deal with the fundamentals of corrosion and its prevention. The concluding section of the symposium deals with corrosion problems in various industries including the aircraft, chemical, gas, paper, petroleum, and power industries. (Published 1956 by the Committee of the Symposium on Corrosion, University of Melbourne, Carlton N.3, Melbourne, Australia. 609 pp., £2.10s.)

### Integral Equations And Their Applications To Certain Problems In Mechanics, Mathematical Physics, And Technology

S. G. Mikhlin divides this advanced text into two parts. The first part deals with the fundamentals of integral equations, while the second and larger part is given over to practical applications involving one-dimensional and two-dimensional problems such as the statical theory of elasticity, immersed bodies in hydrodynamics, and the theory of oscillations. (1957, Pergamon Press, 122 East 55th Street, New York 22, N. Y. 338 pp., $12.50.)

### Modern American Engineers

Revised Edition

The twelve biographies included in this volume are intended as an inspiration and a stimulant to young people who are considering what career to take up. Edna Yost presents each man as a person as well as a significant contributor to the technological field. The twelve men are picked from a wide range of activities including civil, mechanical, electrical, and mining engineering. In this new edition their careers have been brought up to date since the first edition of 1952. (1958, J. B. Lippincott Company, East Washington Square, Philadelphia, Pa. 182 pp., $3.00.)

### Notes On Analog-Digital Conversion Techniques

Alfred K. Susskind presents the subject matter in three parts. The first discusses systems aspects of digital information processing that influence the specifications for analog-to-digital and digital-to-analog conversion devices. In the second part a detailed engineering analysis and evaluation of a variety of conversion devices is presented. The third part is devoted to a case study based on development work done at the Servomechanisms Laboratory of the Massachusetts Institute of Technology. The book has been reprinted with corrections from the edition published by the Technology Press of Massachusetts Institute of Technology in 1957. (1958, John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Various pagings, $10.00.)

### Reinforced Concrete In Architecture

Aly Ahmed Raafat studies the impact upon modern architecture of the engineering principles underlying reinforced concrete, particularly in the field of thin-shell construction. Surface-resistant forms, prefabricated and prestressed units are analyzed, with many drawings and photographs to show the principles involved and their applications. (1958, Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N. Y. 240 pp., $15.00.)

### Rigid Frame Formulas

Translated from the 12th German Edition

Here A. Kleinlogal covers all single-span types of rigid frames. The formulas for the bending moments and reactions on rigid frames of a number of different types, and many loading conditions can be used to secure results rapidly by the direct substitution of numerical values. The Mohr equation, aided by the diagrams in the book, provides a rapid method for computing displacements of rigid frame structures. Eleven new frame shapes are dealt with in this edition. (1958, Frederick Ungar Publishing Co., 105 East 24th Street, New York 10, N. Y. 460 pp., $14.50.)

### Theory Of Structural Analysis And Design

Aspects of structural analysis included are lateral and out-of-plane loading, curved girders, and space frames. Secondary stresses and participation stresses, including the effect of gussets are discussed by James Michalos, and extensive curves are given for stiffness and carry-over factors. A particular feature is the extensive treatment of arches, including continuous arches and arches with stiff ties, with extensive influence lines and tables for both vertical and horizontal loading. (The Ronald Press Company, 15 East 26th Street, New York 10, N. Y. 552 pp., $12.00.)

### Thomas Telford

L. T. C. Rolt tells the story of a great Scotch engineer who built bridges, roads, aqueducts, and canals. The author has written a more detailed account than has hitherto been available, and at the same time has tried to present a portrait of Telford as a man. In addition to his great engineering feats, Telford served as first president of the Institution of Civil Engineers, and occupies a significant place in the history of engineering. (1958, Longmans, Green and Co., London, England. 211 pp., 25s.)

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**Send to Professor James P. Michalos, Chairman,**
**Department of Civil Engineering, New York University,**
**University Heights, New York 53, N. Y.**

Signature..........................

## NON-ASCE MEETINGS

(*Continued from page 25*)

**International Council of the Aeronautical Sciences.** First International Congress of Aeronautical Sciences, September 8-13, Madrid, Spain. For information write to S. Paul Johnston, director of the Institute of the Aeronautical Sciences, 2 E. 64th St., New York 21, N. Y.

**International Road Federation.** Third World Meeting, October 26-31, Mexico City. Information is available from the I.R.F., 1023 Washington Bldg., Washington 5, D. C.

**Instrument Society of America.** Automation Conference and Exhibit, September 14-19, Philadelphia, Pa. Details from Fred J. Tabery, Conference and Exhibit Manager, 3343 South Hills St., Los Angeles, Calif.

**National Association of Corrosion Engineers.** Symposium, October 5-8, Boston, Mass. For information write M. M. Jacobson, NACE, Watertown Arsenal Laboratories, Watertown 72, Mass.

**National Heat Transfer Conference,** August 18-20, Chicago, Ill., at the Edgewater Beach Hotel. For information write the American Institute of Chemical Engineers, 25 W. 45th St., New York 36, N. Y.

**National Slag Association.** Forty-first annual meeting, October 21-22, Washington, D. C., at the Mayflower Hotel. Information from the Association, 613 Perpetual Bldg., Washington 4, D. C.

**Prestressed Concrete Institute.** Annual Meeting, and Convention of the Institute, September 21-25, Chicago, Ill., at the Edgewater Beach Hotel. Further information available from the Institute, 1958 Convention Committee, Box 391, La Grange, Ill.

**Second National Conference on Applied Meteorology.** Sponsored by ASCE and the American Meteorology Society, September 9-11 at the University of Michigan. Information available from D. J. Portman, Meteorology Laboratory, Civil Engineering Department, 304 West Engineering, University of Michigan, Ann Arbor, Mich.

**Sixth International Congress on Large Dams,** September 15-30, New York City, at the Hotel Statler. Information available from the U. S. Committee on Large Dams, c/o Engineers Joint Council, 29 W. 39th St., New York 18, N. Y.

(*Continued on page 112*)

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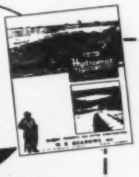

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### NON-ASCE MEETINGS

*(Continued from page 111)*

**Southeastern Association of State Highway Officials.** Meeting, September 30-October 2, Birmingham, Ala., at the Tutwiler Hotel. For information write A. R. Harvey, secretary SASHO, Alabama State Highway Department, Montgomery, Ala.

**World Power Conference.** Sectional meeting of the Conference, September 7-11, Montreal, Canada. Information available from the Canadian National Committee of the World Power Conference, Room 500, 150 Wellington St., Ottawa 4, Canada.

## Applications for Admission to ASCE, June 1-28

### Applying For Member

Kenneth Walter Anthony, North Providence, R. I.
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John Hampton Bomar, Miami, Fla.
Edouard Deslauriers, Montreal, Que., Canada.
Roy A. Finney, Topeka, Kan.
Willard Carroll Hurdle, Sacramento, Calif.
Nat T. Kanarek, Jackson Heights, N. Y.
Stephen Richard Korin, Arlington, Va.
Douglas Carlyle Mackenzie, Pasadena, Calif.
Thomas Alexander Magee, Arlington, Va.
Joseph Augustine McKeon, Washington, D. C.
John Bertram Okkerse, Milwaukee, Wis.
James Henry O'Neill, Detroit, Mich.
Clarence Hart Perry, Marshfield, Wis.
Victor Harriman Poole, Baltimore, Md.
Henry Bernard Shuiling, Jackson, Mich.
Edgar Silbiger, Miami Beach, Fla.
Stewart Ronald Sinclair, Edmonton, Alberta, Canada.
Clifford Douglas Smith, Saskatchewan, Canada.
Duane Parks Smith, San Rafael, Calif.
Harold Glenn Tipton, Frankfort, Ky.
Edward David Tracy, Savannah, Ga.
William Shirley Waggener, Washington, D. C.
Anthony Vincent Witkowski, Oakland, Calif.

### Applying For Associate Member

A Michael Amein, Boston, Mass.
Thongchai Aphornratana, Springfield, Ill.
Maurice Arnold, Auckland, New Zealand.
Amos Atlas, Pittsburgh, Pa.
Tien You Chen, Champaign, Ill.
Felix Garver Corle, Jr., Albuquerque, New Mexico.
Richard Hastings Finney, Topeka, Kans.
Richard Joseph Fisher, San Francisco, Calif.
Leonard Gersten, West Hempstead, N. Y.
Eugene Woodrow Harbert, Denver, Colo.
Norris Arthur Houk, Santa Cruz, Calif.
Walter Kowal, St. Louis, Mo.
Ian Gilroy MacKenzie, Pittsburgh, Pa.
Prodyot Kumar Mallick, West Bengal, India.
Diran Nassir Mansour, Baghdad, Iraq.
Ralph Bishop Marshall, Washington, D. C.
Lloyd McLane, Pomona, Calif.
James Egbert McNair, Jr., Dominican Republic, West Indies.
Giorgio Gaspare Muller, Sao Paulo, Brazil.
Nkemka Obieze, Monrovia, Liberia, West Africa.
William James O'Neill, Rolla, Mo.
Jacques Joseph Odilon Palgen, Baghdad, Iraq.
Paul Parks, Boston, Mass.
Delmar Wallace Pinkston, Crawfordsville, Ind.
John Theodore Poulos, Jr., Wilmington, Del.
John Bolivar Rael, Espanola, New Mexico.
Mumtazul Haque Rehman, Montreal, Que., Canada.
John Paul Robinson, Cincinnati, Ohio.
John Vernon Robinson, Lower Huff, New Zealand.
Arnold Stanley Rosner, Youngstown, Ohio.
Billy Joe Schroeder, Ft. Lauderdale, Fla.
Shingara Singh Sekhu, Punjab, India.
Neill Rahn Smiley, Topeka, Kans.
Jankie Nanan Supersad, Evanston, Ill.
Keith Gier Tranbarger, Los Angeles, Calif.
Uygur Vural, Lincoln Park, Mich.

### Applying For Affiliate

Robert Cullen Smith, Columbus, Ohio.

### Applying For Junior

Woodrow Linwood Brock, Gary, Ind.
Quido Anthony Cappelli, New York, N. Y.
Vernon Eugene Cook, Yakima, Wash.
John Frederick Dreher, Storrs, Conn.
Sid Ahmed El Jack, Chicago, Ill.
Joseph Andrew Ferenz, Astoria, L. I., N. Y.
Robert McBurney Hayes, Newport News, Va.
Shoi Yean Hwang, Fort Collins, Colo.
Mohammed Khader Ali, Orissa, India.
Leandro Yanza Mercado, Olympia, Wash.
Marianne Mueller, Flushing, N. Y.
Paul Warren Norman, Tampa, Fla.
Noel Rojas Salas, Caracas, Venezuela.
Billy Rose, Cambridge, Mass.
Chieh-Shyang Song, Minneapolis, Minn.
Frank Warren Vitek, Peapack, N. J.
Raymond Alfred Winton, Marysville, Calif.
Khalid Mahmond Yasin, Champaign, Ill.

[*Applications for Junior Membership from ASCE Student Chapters are not listed.*]

MH

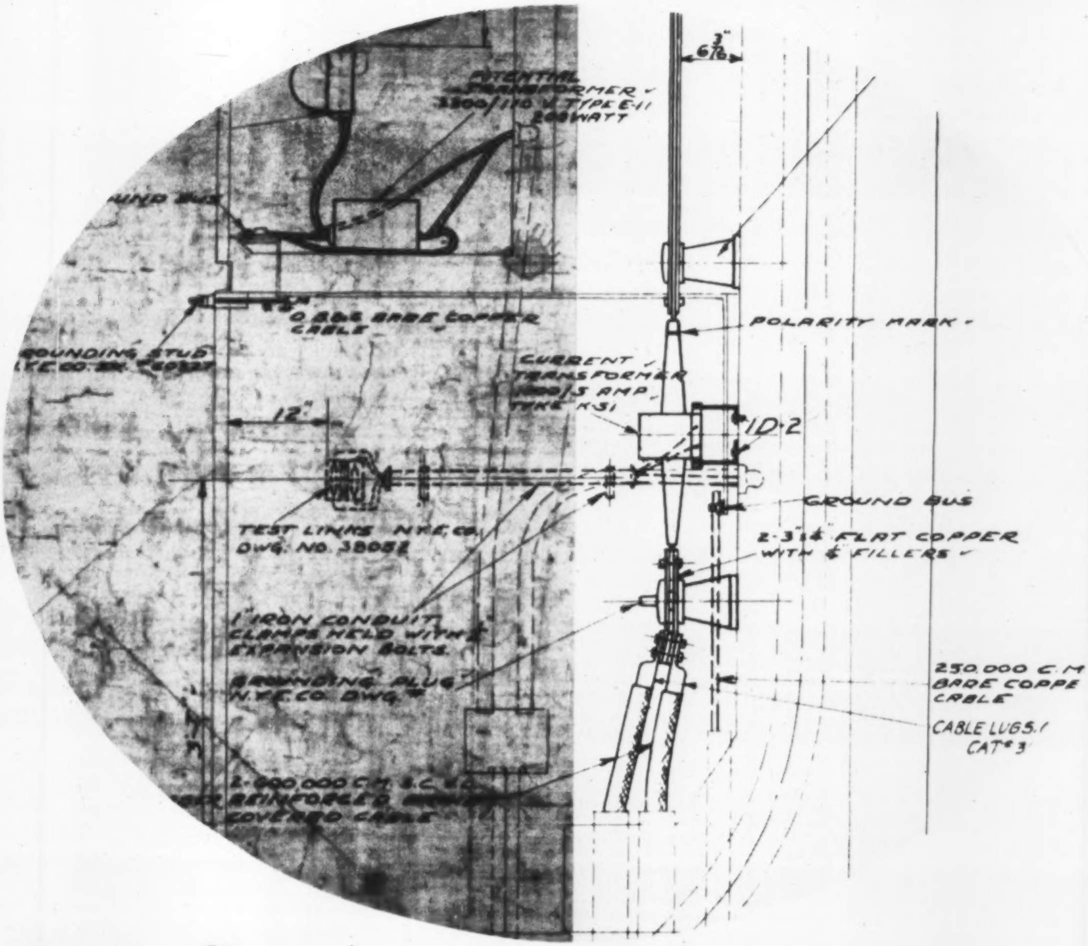
**EASY TO INSTALL CUTTING-IN VALVES FOR BETTER CONTROL**

**MECHANICAL JOINT**

M & H Cutting-In Valves and Cutting-In Sleeves have mechanical joints designed to work with various classes of cast iron pipe. By cutting a short section of correct length out of an existing pipe line, the Sleeve and Valve are easily installed by unskilled workmen. The Cutting-In Valve is the same design, construction and materials as M & H A.W.W.A., double disc gate valves, except for the mechanical joint and connections designed to work with various outside diameters of different classes of pipe. These valves are available with O-Ring seal or conventional stuffing box. Sizes, 4" through 12". Write or phone for details.

**M&H VALVE**
**AND FITTINGS COMPANY**
ANNISTON, ALABAMA

SUBSIDIARY OF WALWORTH


POTENTIAL TRANSFORMER
3300/110 V TYPE E-11
200 WATT
GROUND BUS
0 B&S BARE COPPER CABLE
GROUNDING STUD
N.Y.E. CO. SK. #60327
CURRENT TRANSFORMER
1000/5 AMP
TYPE K-31
12"
6 7/16
3"
POLARITY MARK
1D-2
GROUND BUS
TEST LINKS N.Y.E. CO.
DWG. NO. 38052
2-3"x¼" FLAT COPPER
WITH ¼" FILLERS
1" IRON CONDUIT
CLAMPS HELD WITH ¼"
EXPANSION BOLTS.
GROUNDING PLUG
N.Y.E. CO. DWG. #
250,000 C.M
BARE COPPE
CABLE
CABLE LUGS. 1
CAT# 3
2-1,000,000 C.M. S.C. V.C.
REINFORCED
COVERED CABLE

# **Cronaflex** prints clean:

TRADEMARK

## Eliminates kinks, smudges, creases from original drawing

Examine these two prints. The one on the left, on cloth, bears the same scars of age and wear as the old original drawing. The copy on the right, made from the same original, is on Cronaflex. See how Cronaflex has eliminated the kink marks, cleaned up the smudging—actually improved the drawing.

Corrections can be made right on your Cronaflex copies . . . in either pencil or ink. Even photographic lines can be removed, then corrected, *on either side of the film* because Cronaflex is double-matted.

Your drawings on Cronaflex are rugged. They can be used to make literally hundreds of copies on standard reproduction machines. Also, your Cronaflex copies will not smear or discolor with constant handling, like cloth does.

For more information on this new line, see your Du Pont Technical Representative, or write: E. I. du Pont de Nemours & Co. (Inc.), Photo Products Department, Wilmington 98, Delaware. In Canada: Du Pont Company of Canada (1956) Limited, Toronto.

This advertisement was prepared exclusively by Phototypography.

DU PONT

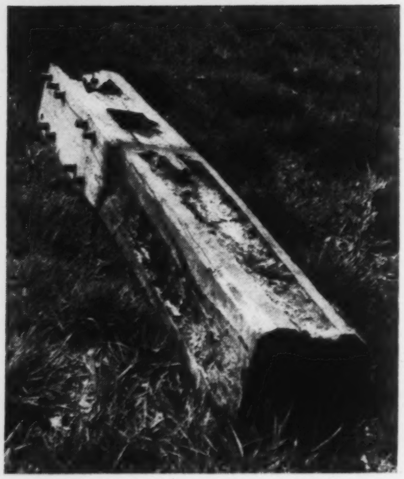
REG. U. S. PAT. OFF.

**Better Things for Better Living . . . *through Chemistry***

**Mr. Clinton Peterson,** Division Engineer of Maintenance, examines a pressure-creosoted post.

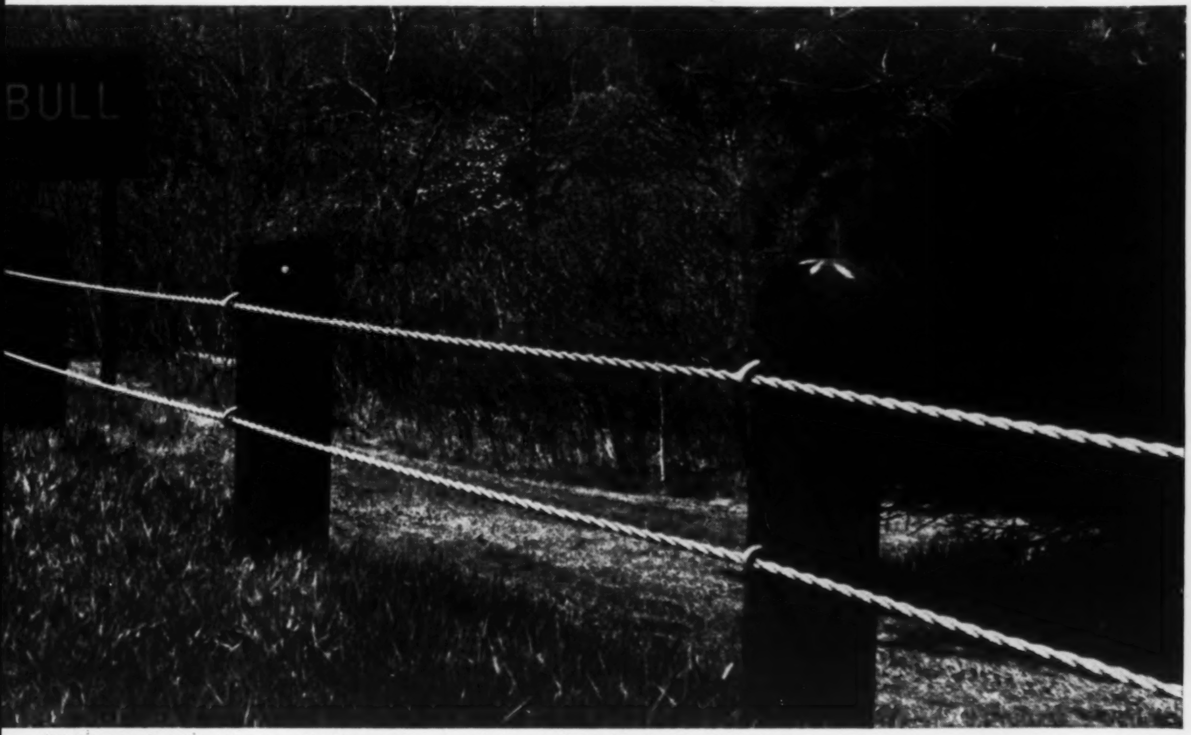
**The Merritt Parkway** in Connecticut, opened in 1938, was one of the first of the modern toll roads. The original rustic guard rails were generally of oak or chestnut dipped in a preservative bath. These showed early signs of deterioration according to Mr. Clinton R. Peterson, Division Engineer of Maintenance. Some of the posts lasted only five to ten years—and replacement was costly.

Obviously a change had to be made to save taxpayers' money. Wood preservation experts from the highway department, a university forestry school and the Connecticut Agricultural Experiment Station began a study. After much experimentation, the conference reported



Posts untreated
rot out in 5 to 10 years.

# Pressure-creosoting doubles the life of guard rail posts on Merritt Parkway



**135,000 feet** of guide railing, supported by pressure-creosoted posts, is used on the Merritt Parkway. Note the reflectors on the posts for night visibility.

that *pressure treatment with creosote was the preferred choice of all these authorities.* At that time, full-length pressure-creosoted posts were made the standard in the state. Pressure-creosoted posts have a life expectancy of 25 to 30 years.

The original rustic railings were replaced with steel cable guard rails firmly supported by pressure-creosoted posts. The domed-top post was favored for its looks and water shedding ability. Some beveled-top posts were used and appear to have about equal life.

This experience on the Merritt Parkway and other Connecticut highways verifies the results being obtained all over the country. The deep penetration of pressure creosoting is needed to assure adequate protection—not only from rot but from termites and other wood destroying insects as well.

**U. S. Steel does not make pressure-creosoted posts but supplies much of the creosote used by the treating industry. Why not take advantage of this easy way to reduce highway costs? Pressure-creosoted posts are readily obtained in most areas. For information, write United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.**

*Creosote's Past Assures Wood's Future*

**Sales Offices** in Pittsburgh, New York, Chicago, Salt Lake City and Fairfield, Alabama.

USS Creosote

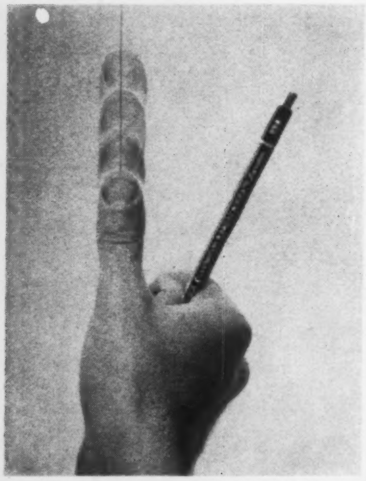
TRADEMARK

# EQUIPMENT, MATERIALS and METHODS

NEW DEVELOPMENTS OF INTEREST AS REPORTED BY MANUFACTURERS

## New Drafting Materials

ONE OF THE NEWEST drafting materials available to engineers is a polyester film made by E. I. du Pont de Nemours & Co., Wilmington, Del., called Mylar. The slick drafting surface of Mylar must be processed to give it a matte surface that will "take" ink or pencil lines. Several companies process the basic Mylar film and offer it under various trade names. Among them, Keuffel & Esser Co., Hoboken, N. J. long-time suppliers of tracing cloth, markets the new matte-surface film under the trade name Herculene. This new drafting film is safe against damage by moisture, and seems to stand up well under repeated handling, erasing and reproduction. Its cost compares favorably with tracing cloth.



Won't Smudge On Mylar

Pencil drawings on these matte-surface films can be made proof against smudging in handling by using a new type of drafting pencil in which the "lead" has a plastic base, instead of graphite. The new pencil called Duralar is a product of J. S. Staedtler, Inc., Hackensack, N. J. Drawings made with Duralar pencils can be cleaned-up with soap and water and will reproduce many times by direct printing, or by microfilm in a satisfactory manner. Chemistry is taking another step toward eliminating India ink in the drafting room and putting the cork back in the bottle permanently. **J. S. Staedtler, Inc., CE-8, Hackensack, N. J.**

## Volumetric Differential Pressure Transmitter

DESIGNED FOR THE PURPOSE of simplifying difficult flow and liquid level measurements, this instrument completely eliminates a wide variety of costly special installations and the maintenance of winterized lead lines ordinarily required between transmitter and process. The transmitter is equally effective with slurries of salt, metal or alcohol slops, with bleach, dye liquor, or paper pulp solutions and neither viscose, liquid sulfur, sulfuric or HF acid, present any added installation problems.

The entire sensing system, including the two sensing elements, their capillaries, and the differential pressure sensing diaphragm to which they connect, is factory-filled with silicone compound and permanently sealed. These components are built-in, integral parts of the primary (or differential pressure sensing) portion of the instrument. Two types of sensing unit assemblies are provided; one, for mounting flush with the inside of chemical tee for pipe installation, the other, for mounting on a standard 3-in. flange. The temperature limit is 300-F at the sensing diaphragms and pressure limit is 1500-lb.

The sensing elements directly contact the fluid in the pipe or tank, at two points, and relay the pressure differential to the secondary portion. Since conventional lead lines are not required, the transmitter can be mounted at ground level, with sensing elements overhead. The risk of danger to maintenance personnel is eliminated and the transmitter is free from damage or shutdown caused by corrosion, plugging, etc. **Taylor Instrument Companies, CE-8, 95 Ames St., Rochester 1, N.Y.**

## New Technique Facilitates Seepage & Pollution Control

PREFABRICATED ASPHALT LININGS, BONDED together to form one huge waterproof blanket and placed without cover directly over prepared earthen surfaces are being used in every section of the country, in the elimination of seepage and pollution on industrial and municipal reservoirs, canals and waterways. For instance, a chemical plant in Washington State used more than 700,000-sq ft of linings in seepage and pollution proofing control on a large chemicals pit. Oil and petrochemical industries line salt water and brine pits in secondary recovery and LPG storage operation.

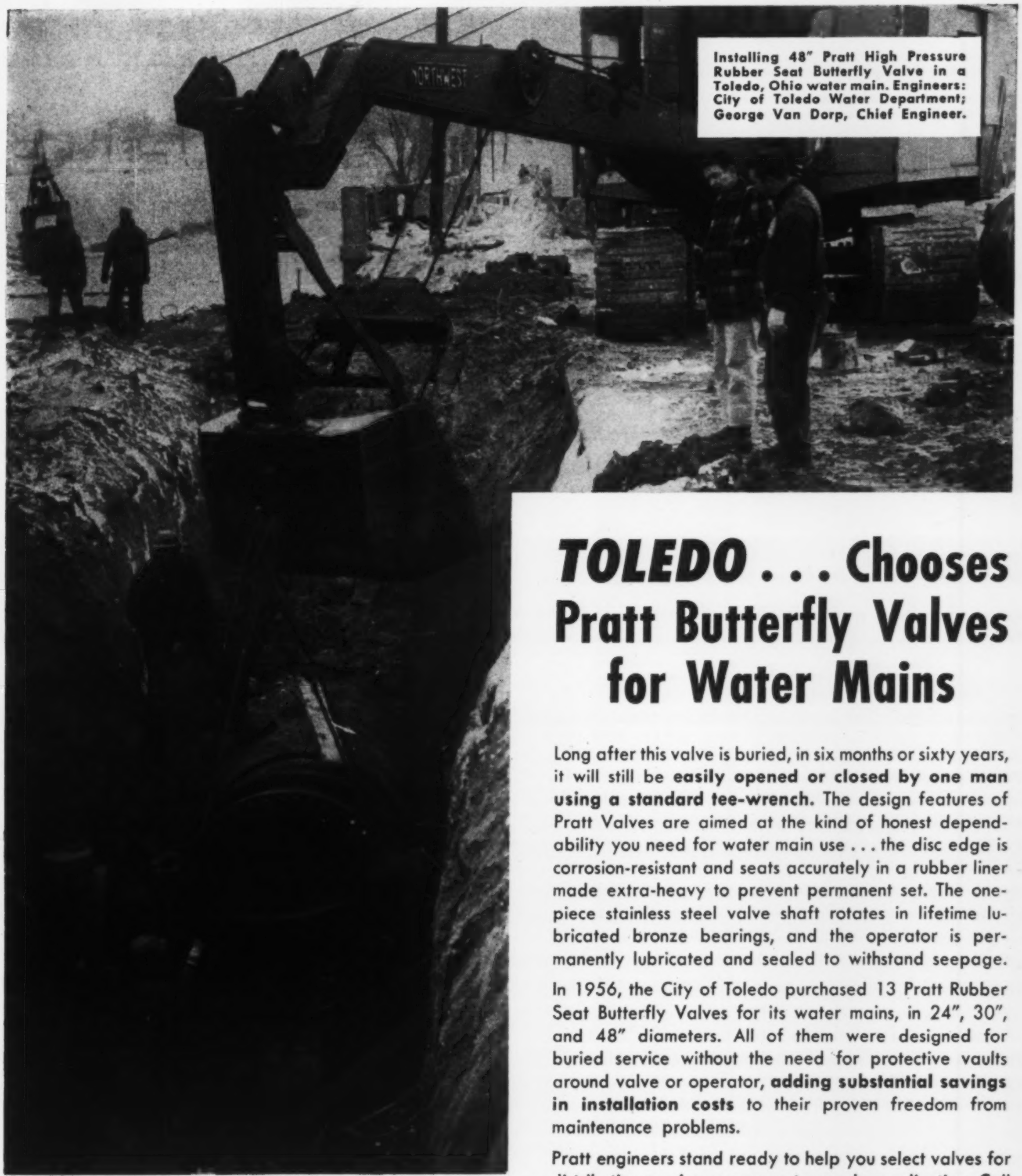
A dramatic use of the linings is on cracked and seeping monolithic hydraulic structures. Adhesive mastic is used to bond the linings to the interior vertical walls and floors of the structure, in combination with mechanical anchorage of stud bolts and cinch beams.

The linings are ½-in. thick, 3-ft wide and usually 12-ft long. The specific gravity is 1.25, sufficient to prevent "floating" under extreme hydraulic velocities. All sheets are factory coated for heavy-duty weathering characteristics, and then factory cut to proper dimension of the individual job.

Installation is fast and simple; a 12-ft sheet weighs 120-lb, about 3⅓-lb per sq ft. The sheets are spotted in approximate position, quickly squared-up in exact position, and then sealed into one huge waterproof blanket, using a butt-joint sealing technique.

Eliminates Seepage & Pollution

Maintenance is at a minimum. The linings "give" to earth movements and to cycles of freezing and thawing, wetting and drying, expanding and contracting to a degree which would impose a serious strain on less flexible substances. Damaged lining is easily and quickly repaired when dry by use of the original sealing mastic. **Gulf Seal Corp., CE-8, Melrose Bldg., Houston 2, Texas.**



**Installing 48" Pratt High Pressure Rubber Seat Butterfly Valve in a Toledo, Ohio water main. Engineers: City of Toledo Water Department; George Van Dorp, Chief Engineer.**

# *TOLEDO* . . . Chooses Pratt Butterfly Valves for Water Mains

Long after this valve is buried, in six months or sixty years, it will still be **easily opened or closed by one man using a standard tee-wrench.** The design features of Pratt Valves are aimed at the kind of honest dependability you need for water main use . . . the disc edge is corrosion-resistant and seats accurately in a rubber liner made extra-heavy to prevent permanent set. The one-piece stainless steel valve shaft rotates in lifetime lubricated bronze bearings, and the operator is permanently lubricated and sealed to withstand seepage.

In 1956, the City of Toledo purchased 13 Pratt Rubber Seat Butterfly Valves for its water mains, in 24", 30", and 48" diameters. All of them were designed for buried service without the need for protective vaults around valve or operator, **adding substantial savings in installation costs** to their proven freedom from maintenance problems.

Pratt engineers stand ready to help you select valves for distribution service or any water works application. Call on them with your next valving problem.

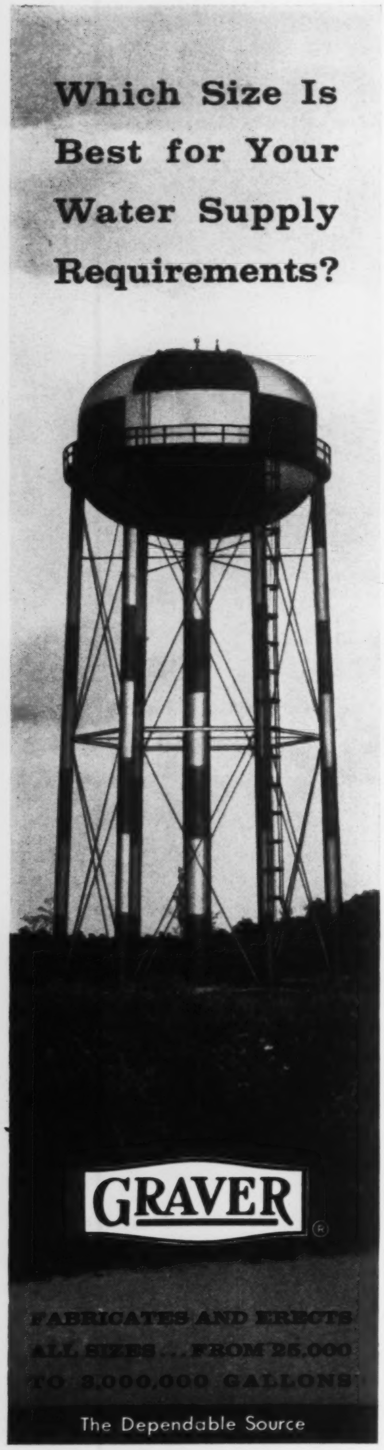
**Have you sent for your copy?** . . . of Pratt's 40 page Manual of Rubber Seat Butterfly Valves. Useful—contains latest pressure drop and flow data, conversion tables, butterfly valve theory and application. Catalog B-2B

Butterfly Valves

HENRY
PRATT

RUBBER SEAT
Butterfly Valves

**Henry Pratt Company, 2222 S. Halsted St., Chicago 8, Ill. Representatives in principal cities**



Which Size Is Best for Your Water Supply Requirements?

GRAVER

FABRICATES AND ERECTS ALL SIZES . . . FROM 25,000 TO 3,000,000 GALLONS

The Dependable Source

GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA
New York • Philadelphia • Edge Moor, Delaware
Pittsburgh • Atlanta • Detroit • Chicago • Tulsa
Sand Springs, Oklahoma • Houston • New Orleans
Los Angeles • Fontana, California • San Francisco

for Elevated Water Tanks

# EQUIPMENT, MATERIALS and METHODS

(continued)

## Radial Saw

An improved 16-20-in. radial saw features a precision index plunger that permits the operator to make quick, positive settings at the most-used angles and a clamping device that assures positive settings at all other angles. The company has also introduced two new accessories for the saw that increase its productivtivity: a safety return and a chain feed control.

The improved saw incorporates the exclusive features of previous models such as the double overarm construction, safe "up-front" controls, lifetime trackway, and low rise motor. Faster blade positioning with the new clamping device and the indexing plunger boosts production and also eliminates the possibility of spoilage even if the operator accidentally bumps or jars the carriage.

Consisting of an adjustable cable-retrieving reel with a special return attachment which extends freely yet has just the right amount of tension to return the saw carriage, the Safety Return attachment increases safety while reducing operator fatigue, particularly on repetitive cutting operations.

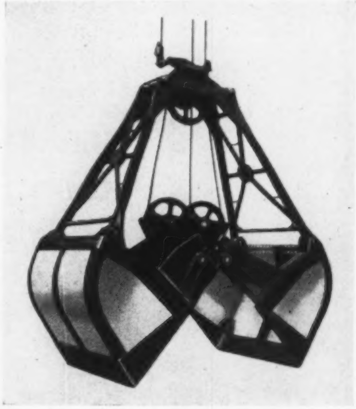
Able to reduce waste and rejects, the Chain Feed Control will give a constant, steady feed for cutting non-ferrous metals, rafter notching, and other operations where carefully controlled feed is required. Its design permits the operator to switch to regular saw operations in seconds without disconnecting or removing the Chain Feed from the over-arm and slowing down his production. **Delta Power Tool Div., Rockwell Manufacturing Co., CE-8, 487 N. Lexington Ave., Pittsburgh 8, Pa.**

## Aluminum Bucket

Aluminum has been introduced into the construction of power crane clamshell buckets for the handling of coal and other free-flowing materials. Its use in buckets of 3 to 10-cu yd capacity (2.5 to 8.5 tons of coal) has the advantage of reducing materially the dead weight of the bucket up to 1,000-lb. This means an increase in pay load in the handling of materials.

In the design of the bucket, the company also has incorporated other features to minimize wear and strain on parts, and on the crane on which it is mounted. Tandem positioning of the lower closing sheaves permits the closing line lead to function in the center plane of the bucket, thus eliminating bending of the cable at the guide rollers as the bucket is hoisted. It also permits the bucket to hang plumb from the crane boom, eliminating cable wear from the bucket "cocking over." Cutting edges, corners and other surfaces exposed to rough treatment are made of steel to withstand the abuse to which the bucket is subjected when working in railroad cars, barges and boats.

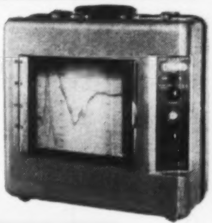
The use of high-strength, abrasion-resistant alloy aluminum plate in side and bottom plates of the bucket has three principal advantages, the company says. These are: it permits use of a bucket of greater capacity than that specified for a given crane; lighter weight can offset the weight of other desired features, such as equalizer bars or holding sheave blocks; and the weight savings reduce the crane load, resulting in faster crane operation and lower maintenance costs. **The Owen Bucket Co., CE-8, 6001 Breakwater Ave., Cleveland 2, Ohio.**



Aluminum Construction

## Expand-O-Trol

A precision mechanical self-contained torque control unit for controlled tube rolling has been developed. The Expand-O-Trol is an attractive item because of its low initial costs and its adaptability to your available air or electric tube rolling motors. It is priced to be bought as a maintenance tool. The unit measures the tightness of expanded tube joints by utilizing the torque resistance of the expanding tube, resulting in uniformly rolled tube joints within the tube bundle. The danger of tube sheet warpage is minimized and the tube joint failure is decreased. The Expand-O-Trol consists of few parts, making the unit practically maintenance free. Through compactness the size-weight ratio is minimized. The design incorporates a slip-clutch with a friction wear compensating arrangement. When the desired torque is reached, the special metallic-embedded fiber disc slips against the mating steel hub thus discontinuing further expansion. **The Gustav Wiedeke Co., CE-8, 1833 Richard St., Dayton 1, Ohio.**



**ES 130**
**SURVEY**
**DEPTHOMETER**

For salvage, submarine survey and channel inspection . . . all-purpose. Completely portable, lightweight . . . four scale ranges 0/65 feet, 60/125 feet, 120/185 feet and 180/245 feet. Accuracy ½ of 1%. Operates on 6 or 12 volts DC or 115 volts AC. Single transducer. Base price **$1175.**

**UNDERWATER TV CAMERA**

**UTH 4**

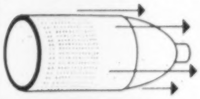
Completely portable 3-unit Closed Circuit TV specially designed for depths to 180 feet. Diver holds camera (approx. 4 lbs. submerged) relays continuous high definition picture to Monitor screen on boat or land. Complete with surface Control Unit. Approx. **$4,000.**

*Brochures mailed on request • All prices F.O.B. New York*
*Write for name and address of dealer nearest you*

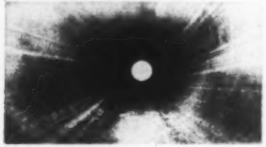
**BLUDWORTH MARINE**

Division of KEARFOTT COMPANY Inc.
1500 Main Avenue, Clifton, N. J.

there's a better way to get it done!



Liner compresses cement mortar onto interior



Gives smooth, continuous, water proof lining of correct thickness

Tate Process applies cement mortar lining to the interior of 4" to 16" lines quickly and economically . . . while the lines stay "in place." Permanently restores full flow coefficients. Reduces pumping and maintenance costs. Protects against corrosion, contamination.

*Write for full information TODAY!*

**Specializing in Pipe Protection Problems**
• Tate and Gentriline "In Place" Interior Cement Mortar Lining • "In Plant" and "Railhead" Centrifugal Spinning of Cement Mortar or Coal Tar Linings – Somastic® Exterior Coating • Pipe Wrapping • Reclamation: Removal of Old Wrapping, Straightening, Blasting, Beveling, Testing.

**PIPE LININGS**

A Division of American Pipe and Construction Co.

2414 East 223 St. (P. O. Box 457)
Wilmington, California

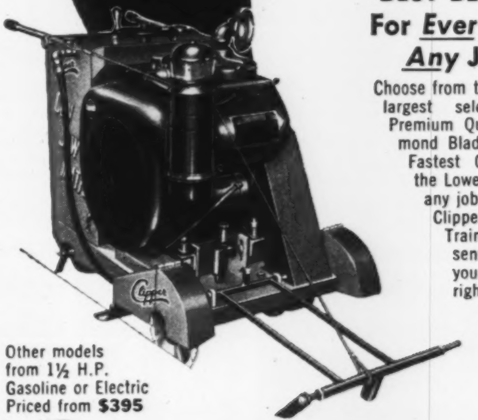
**SAW CONCRETE & ASPHALT *FASTER* WITH THE *ALL-NEW***

**Clipper**
"SAILS RIGHT THRU"
® **SELF-PROPELLED**

**36 H. P. CONCRETE SAW**

***Over 36 Outstanding Features Found on No Other Concrete Saw!***

Here is Engineering Leadership by Men Who Know the Concrete Sawing Industry



***BEST BLADES***
**For *Every* Saw *Any* Job!**

Choose from the world's largest selection of Premium Quality Diamond Blades for the Fastest Cutting at the Lowest Cost on any job. Let your Clipper Factory Trained Representative help you select the right Saw and Blades for your job!

**Call him Collect Now!**

Other models from 1½ H.P. Gasoline or Electric Priced from **$395**

**Genuine Clipper Products Sold Direct—Immediate Shipment From Factory Branches Coast To Coast**

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**2806 WARWICK • KANSAS CITY 8, MO. 429X**

- ☐ Send Information on Your 36 H. P. CONCRETE SAW
- ☐ Send Information on ALL Models Concrete Saws
- ☐ Send Information on Clipper Premium Quality DIAMOND and GREEN-CON Abrasive Blades
- ☐ Send My Clipper Factory Trained Representative to see me.

NAME ______________________

ADDRESS ______________________

CITY ______________________

STATE ______________________

# EQUIPMENT, MATERIALS and METHODS

(continued)

## Contourometer

THE MANUFACTURERS OF THE Contoura-Portable photocopiers have announced a voltage meter for engineers' and builders' field and office use with portable photocopiers. Called the Contourometer, the new accessory completely eliminates timing guesswork and resultant time and materials waste in photocopying. The new regulator-meter was developed for those who use the Contoura-Portable for copying deeds, tracings, bids, blueprints and specifications in the field. Incoming current can be set at 110 volts in the engineer's or builder's office and locked in place. Typical materials to be copied in the field can then be tested for precise timing at this voltage. In this way, the amount of lumens hitting the copying paper are held constant under widely varying power conditions, or even peak load circumstances, in unfamiliar buildings. Recopying, due to over or underexposed copies, becomes unnecessary. With a certainty of perfect copies in the field, the engineer no longer needs to carry developing chemicals for field work. In the office, the meter maintains constant light intensity during varying current usage for photocopying of correspondence, invoices, reports and charts and all technical data. This eliminates copying by typing and proofreading, as well as dependence on commercial copying facilities. **F. G. Ludwig, Inc., CE-8, 105-C Coulter St., Old Saybrook, Conn.**

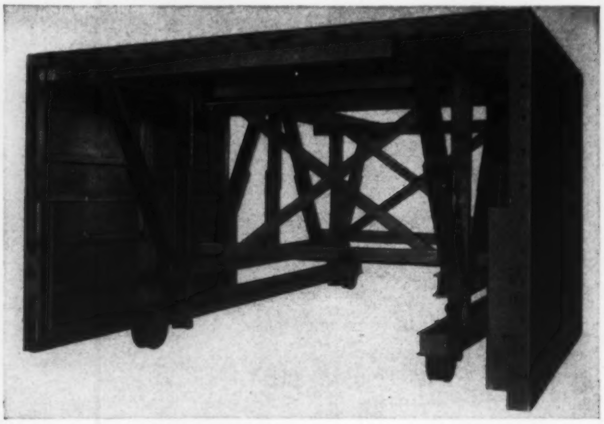
## High Strength Steel

GEORGE S. RICHARDSON, CONSULTING engineer for the Pennsylvania Department of Highways, specified the use of high strength for critical stress portions of the 750-ft Fort Pitt Bridge to cross the Monongahela River at Pittsburgh's famed Golden Triangle. The 118-ton Man-Ten Steel end post, together with three like vertical members for the portals, will support the 8,500-tons of fabricated steel to go into the bridge. The steel in the end posts was chosen because of its high yield point and other desired properties. The designers specified a double-deck, tied arch structure because of its aesthetic appeal and its ability to span the entire width of the river to comply with navigation requirements. **United States Steel Corp., CE-8, 525 Wm. Penn Place, Pittsburgh 30, Pa.**

## Front-End Loader

ACCORDING TO THE MANUFACTURER, the Payloader is the first rubber-tired, front-end loader with a rated carrying capacity of 2,500-lb. A combination of numerous new design features is expected to establish new standards of production and ease of operation. Although the Payloader has more capacity and is larger and heavier, it can be operated in and out of boxcars having 6-ft doors. It actually has a shorter turning radius (6-ft to the outside rear hub) than any other rubber-tired, tractor-shovel. Power-steering as a standard feature assists both maneuverability and ease of handling. A new power-shift transmission and new torque-

(*Continued on page 122*)



POSEY STEEL FORMS

- Telescoping and Non-Telescoping Forms For Tunnels, Sewers and Conduits
- Air Locks and Lock Doors For Concrete Bulkheads
- Jumbos for Drilling, Timbering and Concreting
- Head Frames, Cages, Special Muck Cars, Self-Dumping Skips, and Muck Bins
- Special Equipment For Underground Construction

Posey Iron has the engineering experience and production facilities to handle all of your requirements for fabricated steel tunnel forms. For every job, big or small, Posey gets the work out as and when promised. Write, wire or phone without any obligation.

POSEY IRON WORKS, Inc.
*Tunnel and Mine Equipment Division*
LANCASTER, PENNSYLVANIA
*New York Office: Graybar Building*

TANKS • STACKS • DIGESTERS • PIPE • PILING

All internal parts, including the drain valve seat, are drawn through the top of the hydrant without disturbing the standpipe.

# We can show you – right in your office – why Mathews dry-head construction is so important

No community can afford to take chances with its hydrants. They *have* to work—not just when they're new, but in every single emergency during the course of a long, long life. That's why the dry-head construction of the Mathews Flange Barrel Hydrant is so significant. It keeps sand and ice and sediment from accumulating and interfering with its instantaneous operation, a feature that can be highly important.

We can actually show you what we mean without even asking you to get up out of your chair. We'll bring our scale model to your office and disassemble it so that you can see its inner workings. Why not write us today and ask for one of our representatives to show you these important features.

Made by

**R. D. WOOD COMPANY**

Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers of Mathews Hydrants and "Sand-Spun" Pipe (centrifugally cast in sand molds)

KERN
GETS YOU OUT
(of traffic and crowded areas)
IN A HURRY

TURN TO
KERN INSTRUMENTS
for increased working speed, simplicity and economy of operation, higher degree of accuracy.

45 SEC. SET-UP TIME with
KERN
GKI LEVEL
and KERN (Ball & Socket) TRIPOD

- Unique new design—no leveling screws.
- Compact, functional, highly portable.
- Fast, effortless operation.
- Fine tilt screw; coincidence spirit level.
- Mean accuracy as high as 13/1000 ft. per mile.

$251.50 GKI LEVEL
Including Fixed Leg Tripod

★

REVOLUTIONARY NEW TRIPOD
Levels instrument with remarkable speed. Assures exceptional stability with ball-and-socket head supporting instrument coupling.

★

*Write for Brochure GK 479-2*
PROMPT, RELIABLE SERVICE
FACTORY TRAINED PERSONNEL

Kern SWISS
*The FINEST in SURVEYING EQUIPMENT*
KERN INSTRUMENTS INC.
120 Grand St., White Plains, N.Y.

## EQUIPMENT MATERIALS and METHODS

### (continued)

converter are matched to provide the maximum in speed of movement and ease of operation. The transmission is full-reversing and has two speeds. Another feature of the power-train is the power-transfer differential which automatically transfers more torque to the drive wheel with the best footing when slippage is encountered. The large-diameter hydraulic brakes have an automatic adjustment and are sealed against dust, dirt and solid foreign material. An access panel at the front of the machine makes it easy to inspect and service the master brake cylinder. **The Frank G. Hough Co., CE-8, Libertyville, Ill.**

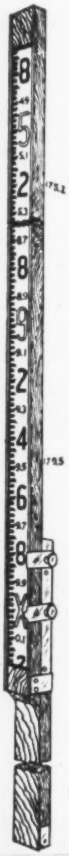
### Model 200 Hopto

A NEW AND IMPROVED carrier-mounted ⅜-yd Model 200 Hopto that can travel on the highway at speeds up to 50-mi per hour has been developed. This earth moving machine is mounted on a motorized carrier, which has a 16,000-GVW rating and a 124-in. wheelbase.

Powered by a 265-cu in. displacement engine and having a 225-ft lb torque at 1200-rpm, the Hopto features a new and more powerful hydraulic system delivering 72-gal of oil per min through a three-unit tandem pump that insures constant power for all actions and simultaneous use of any combination of movements. New controls of the machine include both hand levers and foot pedals for improved operating efficiency and faster operation. It has a 13½-ft digging depth, and a full range of quick change attachments including both backhoe and shovel buckets. Conversion to shovel operation is made by simply changing buckets.

13½-Ft Digging Depth

Other features include a 200-deg uninterrupted swing, heavy duty type boom construction, 180-deg wrist action digging, and individually controlled hydraulic outriggers. **Badger Division of The Warner & Swasey Co., CE-8, 1124 W. Fifth St., Winona, Minn.**



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A SOLID FUTURE...
Concrete

On the Indiana Toll Road they saved $9,740,000 by paving with CONCRETE

**Actual cost figures for the two types of pavement tell the story!**

Indiana Toll Road engineers drew up designs for both types of pavement . . . each to carry the same axle loads, each to be the best of its type. Realistic comparison of *all* paving costs, from grading and subbase preparation to finished surface, gave the answer: *Concrete would save $62,436 per mile!*

Indiana's experience demonstrates once more that concrete can give lower initial cost. And you get a pavement of mathematically accurate load-bearing strength—with a safety factor for overloads.

Add to this, concrete's life expectancy of 50 years and more, with far lower maintenance costs. Add "thump-free" smoothness that pleases the public . . . and the all-weather safety the grainy surface gives. On Interstate and all heavy-duty highways, modern concrete puts quality within your budget.

**Concrete gains strength year by year—up to 20% in the first 5 years. Tests of flexural strength prove that only concrete gives this load-bearing "bonus."**

**PORTLAND CEMENT ASSOCIATION**

*A national organization to improve and extend the uses of concrete*

acker
LD core
drills

"ALWAYS GET THEIR CORES!"

Acker's low-cost LD Core Drill was specifically designed for sensitive, hand lever feed drilling to permit even unskilled operators to recover core from broken difficult formations.

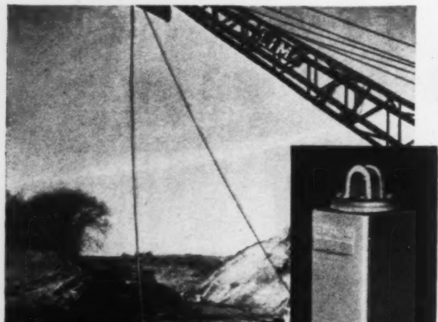
Even so, we were particularly gratified to learn from the Boring Soils & Testing Co., that their Acker LD Rig successfully obtained cores from extremely difficult coral rock formations in Bermuda. This, despite the failure of other rigs to obtain cores!

The LD is completely self-contained and is available for jeep, trailer, truck or skid mounting. It makes *diamond core drilling possible even in the roughest terrain!*

If you want more information about the Acker LD, please write for Bulletin 21CE.

**ACKER DRILL CO., Inc.**
**P.O. BOX 830 • SCRANTON, PA.**

*Over 40 years of experience manufacturing a complete line of diamond and shot core drills, accessories and equipment.*



*Fast-Driving, Versatile*
**VULCAN**
**DGH-100**
**PILE HAMMER**
***speeds work on sewer project***

The Vulcan DGH-100 Portable, Differential-Acting Hammer is driving 3″ x 8″ x 24′ timbers to a depth of 20 feet to form bins 8′ wide and 24′ long used in the construction of a sewer line in Edina, a suburb of Minneapolis. Contractor: Phelps-Drake Co., Minneapolis. The Vulcan DGH-100 is a favorite with contractors everywhere.

*Ask for full information*

*Manufacturers of Pile Driving Hammers and Piling Extractors Since 1852*

**VULCAN** IRON WORKS INC. 327 North Bell Avenue, Chicago 12, Illinois

# EQUIPMENT MATERIALS and METHODS

(continued)

## Portable Asphalt Plant

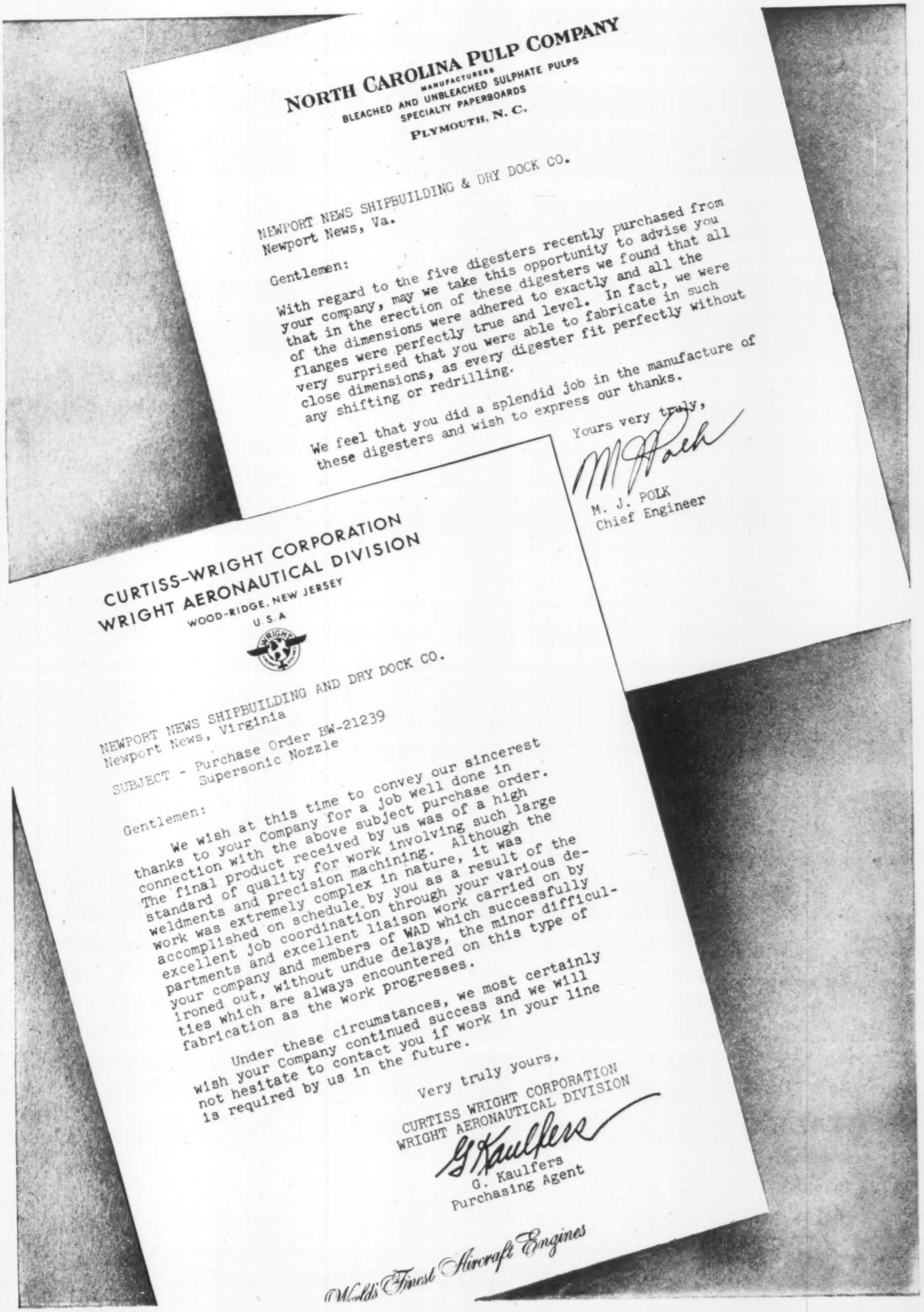
Easy to operate, practically automatic, and requiring only one operator, the new Portable Asphalt Plant has a rated capacity of 30-tons per hour. Some of its features are: a 5-ton dual feeder bin which proportions and feeds aggregate directly into the dryer; a 30-ton rotating dryer made of heat resistant Cor-Ten steel with an economical counterflow burner system and even-veil lifting flights which give efficient drying action; an enclosed hot elevator which delivers a continuous cascade of aggregate; a 5-ton storage hopper which holds and discharges aggregate as required; a 1000-lb batching hopper; a 1100-lb twin-shaft type pugmill with precision type steel wear plates, chrome molyodenum steel tipped paddles which thoroughly mixes and dumps half-ton batch every 60-sec; and a self-elevating platform, permitting the discharge of bituminous concrete directly into the trucks. **Littleford Bros., Inc., CE-8, 453 Pearl St., Cincinnati 2, Ohio.**

Practically Automatic

## Concrete Form

Four new and distinctive field-tested concrete forms—two textured and two smooth-faced—have been announced. The new faces give the company a complete line of concrete forms—a total of five differently faced panels, each of which can be exploited for a different function in concrete finishing. They are: Formtex, for grooved or groove-patterned exteriors with minimum finishing; Surf-Form, for decorative patterned surfaces with minimum finishing and upkeep; Weldwood High Density, for up to 200 re-uses at great savings in time and material; Plyform, for up to

(Continued on page 126)



NORTH CAROLINA PULP COMPANY
MANUFACTURERS
BLEACHED AND UNBLEACHED SULPHATE PULPS
SPECIALTY PAPERBOARDS
PLYMOUTH, N. C.

NEWPORT NEWS SHIPBUILDING & DRY DOCK CO.
Newport News, Va.

Gentlemen:

With regard to the five digesters recently purchased from your company, may we take this opportunity to advise you that in the erection of these digesters we found that all of the dimensions were adhered to exactly and all the flanges were perfectly true and level. In fact, we were very surprised that you were able to fabricate in such close dimensions, as every digester fit perfectly without any shifting or redrilling.

We feel that you did a splendid job in the manufacture of these digesters and wish to express our thanks.

Yours very truly,

M J Polk
M. J. POLK
Chief Engineer

---

CURTISS-WRIGHT CORPORATION
WRIGHT AERONAUTICAL DIVISION
WOOD-RIDGE, NEW JERSEY
U. S. A.

NEWPORT NEWS SHIPBUILDING AND DRY DOCK CO.
Newport News, Virginia

SUBJECT - Purchase Order BW-21239
Supersonic Nozzle

Gentlemen:

We wish at this time to convey our sincerest thanks to your Company for a job well done in connection with the above subject purchase order. The final product received by us was of a high standard of quality for work involving such large weldments and precision machining. Although the work was extremely complex in nature, it was accomplished on schedule by you as a result of the excellent job coordination through your various departments and excellent liaison work carried on by your company and members of WAD which successfully ironed out, without undue delays, the minor difficulties which are always encountered on this type of fabrication as the work progresses.

Under these circumstances, we most certainly wish your Company continued success and we will not hesitate to contact you if work in your line is required by us in the future.

Very truly yours,

CURTISS WRIGHT CORPORATION
WRIGHT AERONAUTICAL DIVISION

G Kaulfers
G. Kaulfers
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*World's Finest Aircraft Engines*

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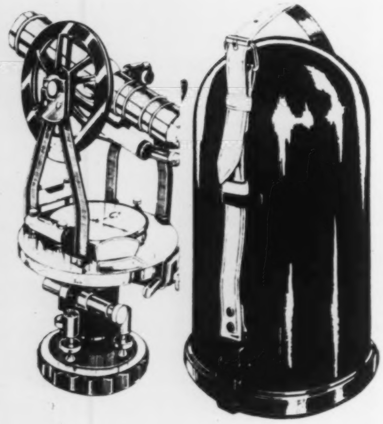
*The Answer Is*

Eagle

LIGHT 4″ TRANSIT

SAVES WEAR AND TEAR ON
MORE EXPENSIVE TRANSITS



Magnification . . . . . . . . . . . . . . . . . 20X
Horizontal Vernier Reading . . . . . . . . . 1′
Tripod Head . . . . . . . . . . . . . . 3½″ x 8
**Weight . . . . . . . . . . . . . . . . . 6.5 lbs.**

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## EQUIPMENT MATERIALS and METHODS

(continued)

50 re-uses on jobs in which a relatively smooth face is required; and Smooth-Form, for maximum economy. Weldwood Concrete Forms are produced in Exterior Grade and L-1R adhesive lines. Exterior Grade is 100% waterproof, unconditionally guaranteed against delamination. L-1R is a specially developed interior-type adhesive which offers superior resistance to mold and a high resistance to moisture. It is guaranteed against delamination for at least 10 re-uses. **United States Plywood Corp., CE-8, 55 W. 44th Street, New York 36, N. Y.**

### Efficiency Recorder

HERE IS A NEW tool for management, engineers, and operators. With startling simplicity and accuracy, the chart shows the 'ON' or productive time as well as the idle or 'down time.' Continuously readable for every instant in percentage of time over the entire shift, be it 8-hr or 31-days. During productive time, the graphic line climbs upward at an angle. During 'down' or idle time, the line instantly becomes horizontal, broad, and very conspicuous. No longer is it necessary to wait until the end of a work shift or time period and have someone make charts and computations on the productivity of operators, machines or processes. The recorder does this for all to see, minute by minute as the hours go by. Not only is the immediate trend shown, but also the average production in percentage from the start of the period. By having information at once, many problems can

Continuously Readable

(*Continued on page 128*)

A Simple Way to EXPOSE CONCRETE AGGREGATE . . . Use RUGASOL

You will find that exposing concrete aggregate with Sika Rugasol is simple because it eliminates the need for costly chipping, hacking or sandblasting There are two types of Rugasol:

*RUGASOL F . . . is painted directly on formwork. When forms are stripped (in 2 to 5 days), the retarded mortar is removed with a jet of water or stiff brush.*

*RUGASOL C . . . is applied on the surface of freshly placed concrete. On the following day, the retarded surface mortar is removed with a jet of water or stiff brush.*

For complete information on Rugasol, call or write for Bulletin RG-58.

Ad 26-4

Sika
SIKA CHEMICAL CORPORATION
PASSAIC, NEW JERSEY

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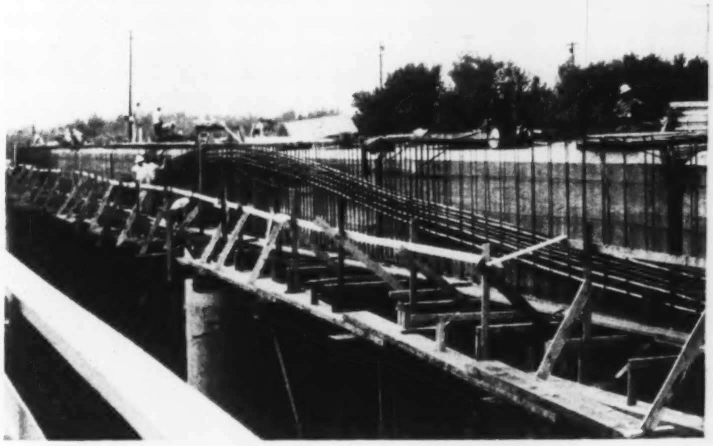
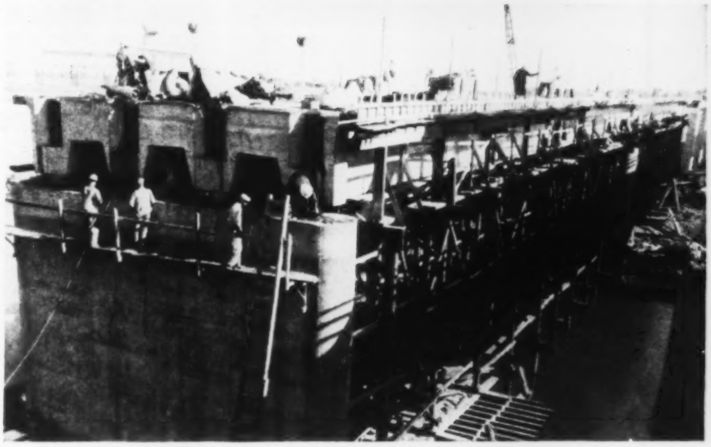
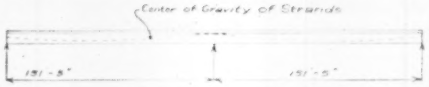
**PRESTRESSED CONCRETE BRIDGE** across Feather River at Marysville, California • Designed by Ben C. Gerwick Inc. with William J. Talbot Jr. as Chief Engineer • Consultants on prestressed concrete continuous spans—T. Y. Lin & Associates • E. E. Watkins, Road Commissioner of Sutter County, Cal. was responsible for the project, with Charles W. Deterding in charge. Contractor—Pacific Bridge Co.



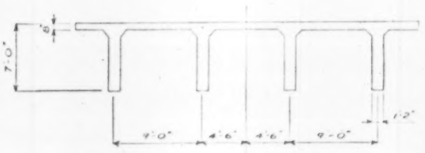
Roebling strands encased in flexible metal hose being placed in form. Path of strands is at highest point over center pier.



End view after completion of jacking.



Elevation of Bridge



Cross-Section at ℄ Each Span

# How to build a long-span vehicular bridge at an initial saving of $12,299

Here is an excellent example of a continuous prestressed concrete bridge, with two 151-ft. spans across the Feather River at Marysville, California. It effects savings—both initial and in operational maintenance—that can only be considered impressive.

As measured by bids, both steel and prestressed, the initial savings were $12,299. Projected maintenance savings as well as insurance savings will accrue over the years to add to this already attractive cost picture.

T. Y. Lin, consultant on continuous prestressed concrete spans, stated in an Engineering News Record article:—

*"General opinion is that cost of long-span continuous prestressed concrete bridges might not be as economical as conventional designs using structural steel. But the bidding and the successful completion of this bridge across the Feather River at Marysville, Calif., indicated that this type of prestressed concrete bridge can be competitive.*

*"A total of only thirty-two 1$\frac{11}{16}$ in. strands (each 300 ft. long) was employed for prestressing the two continuous spans. These cables, supplied by John A. Roebling's Sons Corp., were easily laid, tensioned and grouted. Simple T sections, instead of modified T or box sections, were adopted for the bridge, thus minimizing the cost of formwork and facilitating the placing of concrete.*

*"In addition to the two main spans, the two-lane bridge has 23 spans of 80 ft. precast, prestressed concrete T-beams. Roadway width for the two-lane structure is 28 ft. and sidewalks increase the width between railings to 35 ft. 5 in.*

*"The four cast-in-place T-girders for the continuous spans are spaced 9 ft. c-c and are 7 ft. deep. The 8 in. thick deck forms the flange of the T section."*

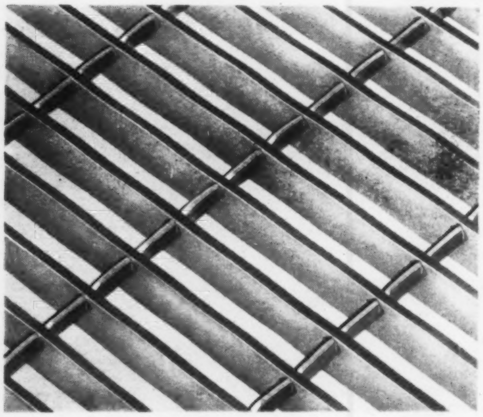
The savings wherever prestressed is employed speak for themselves. We invite you to get in touch with us on anything that has to do with this really remarkable building method. Since prestressed's introduction into this country, we at Roebling have pursued and championed it as a construction mode with the results shown here... and the Feather River Bridge is but one of many, many similar examples. Construction Materials Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

**ROEBLING**

*Branch Offices in Principal Cities — Subsidiary of The Colorado Fuel and Iron Corporation*

NEW!
Gary Galok* SUPER
ALUMINUM GRATING

First improvement in rectangular mesh grating in over a quarter-century!



- High strength-to-weight ratio.
- Cross bars can't turn, come loose or fall out.
- All sizes—¾″ x ⅛″ to 2¼″ x 3/16″.
- Standard mesh with main bars on 1 3/16″ centers and close mesh with main bars on .915 centers with cross bars on 4″ or 2″ centers.
- Safe, slip-proof surface.
- Available in plain or serrated main bars.

*Patents Pending

You'll want full details about this new aluminum grating. Write for Bulletin CE-88.

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GRATING DIVISION
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COMPLETE DATA, SPECIFICATIONS AND DRAWINGS AVAILABLE—WRITE

ZIMMER & FRANCESCON P. O. BOX 359, MOLINE, ILLINOIS

# EQUIPMENT MATERIALS and METHODS

## (continued)

be anticipated and lowered production avoided. The best knowledge is immediate information, not data costly hours later. When wages are tied in with production, the recorder shows all activities, from the worst to the best. The distribution of production or efficiency for the entire period is seen and comprehended at a glance. **Gorrell & Gorrell, CE-8, 338 Old Hook Road, Westwood, New Jersey.**

### Versatile Scraper

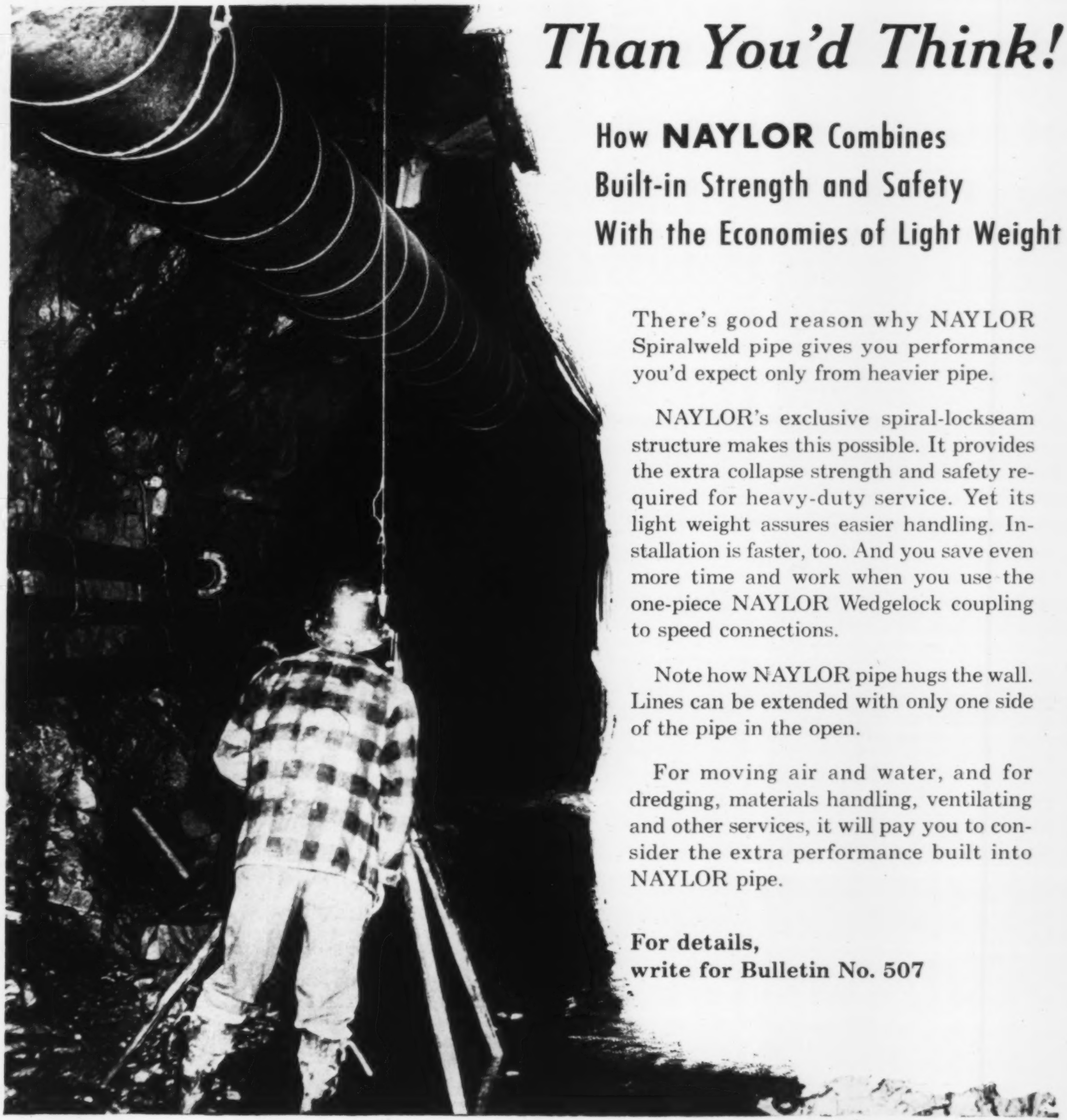
Designed and developed specifically to meet the demands of the earthmoving industry for a high speed, high production, self-propelled scraper, the model CW 215 has a struck capacity of 15.0-cu yd (21.0-cu yd heaped) and can haul 21-ton payloads at speeds in excess of 31-mph.

Powered by a 240-hp Cummins Diesel engine, with a 10-speed forward and 2-speed reverse transmission, the scraper incorporates "Roto-gear" positive steering, said to be one of the safest, trouble-free hydraulic steering systems in use on heavy duty earthmoving equipment.

High Speed

Fast, easy loading in all types of materials is accomplished by boiling-bowl loading, adjustable angle cutting edge and long profile bowl design. The air-operated power control unit is "live" at all times, providing the operator with instant power and immediate response while underway.

Another outstanding feature of the machine is its interchangeability with the CWD 214, 25-ton rear dumper, which permits use of the same tractor for either unit. **Continental Copper & Steel Industries, Inc., Wooldridge Div., CE-8, Sunnyvale, Calif.**



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## How **NAYLOR** Combines Built-in Strength and Safety With the Economies of Light Weight

There's good reason why NAYLOR Spiralweld pipe gives you performance you'd expect only from heavier pipe.

NAYLOR's exclusive spiral-lockseam structure makes this possible. It provides the extra collapse strength and safety required for heavy-duty service. Yet its light weight assures easier handling. Installation is faster, too. And you save even more time and work when you use the one-piece NAYLOR Wedgelock coupling to speed connections.

Note how NAYLOR pipe hugs the wall. Lines can be extended with only one side of the pipe in the open.

For moving air and water, and for dredging, materials handling, ventilating and other services, it will pay you to consider the extra performance built into NAYLOR pipe.

**For details,**
**write for Bulletin No. 507**

**NAYLOR PIPE** *Company*

1281 East 92nd Street, Chicago 19, Illinois
**Eastern U. S. and Foreign Sales Office:** 60 East 42nd Street, New York 17, N. Y.

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- ☐ Engine design calculation
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- ☐ Military and management consultation and operations analysis
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- ☐ Product or organization simulation
- ☐ Other (please describe)

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MAN HOURS PERFORMED
—COST: $1800⁰⁰

It's true! The programming and computer time to solve design problems for a series of telescopes 16", 36", and possibly 400"—twice the size of the largest telescope now in existence—figured out to approximately 30 cents per engineering man hour! It is estimated that a team of 3 mathematical analysts would have required more than one year of manual calculation to solve these complex problems.

Perhaps you have a problem General Electric could solve with similar savings.

*For complete information* WRITE WIRE *or* PHONE **ALpine 4-3171** *—Phoenix*

*General Electric Company*
*Computer Department, Room 110*
*1103 North Central Avenue, Phoenix, Arizona.*

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**TRANSIT**
**$720.00**

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NO REPLACEMENT NEEDED after you acquire a

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The design and construction of these superb instruments is so superior and so different that it is prudent to investigate them. After all, an instrument that can promise a very minimum of repairs and maintenance—and does promise that it will probably never be replaced during your entire remaining professional career should be in YOUR equipment.

**FREE 10 DAY TRIAL**—So sure are we of your reception to this magnificent instrument that we offer it FREE for 10 days trial test on your own work sites. You will find that over 40 superior advantages will save you time, concerning this unique instrument.

*Ask for Bulletin CE-88 that lists Full Details.*

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**136 N. 12th St., Phila. 7, Pa.**

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# The long service life of tar-enameled steel pipe

**ST. LOUIS**—60-in. ID tar-enameled pipe, some 30, some 20 years old, still on the job and reported to have given "uniformly satisfactory service."

**BALTIMORE**—84-in. ID tar-enameled main installed in 1915. Inspections disclose no leaks or loss of flow capacity. Giving good service today after 42 years.

**MINNEAPOLIS**—Portion of 19.5 mi. 48-in. ID tar-enameled steel main crosses Mississippi River, cradled under bridge, completely exposed to the rigorous climate. Through nine years with a temperature range of 132 degrees, the pipe has functioned "perfectly."

**SYRACUSE**—54-in. ID steel pipe installed underwater in 1893 (asphalt lined) and 1938 (tar-enameled). "Inspections indicate that both are in excellent condition today."

**TAMAQUA, PA.**—30-in. ID tar-enameled steel pipe used continuously since 1932. Despite highly corrosive coal-bearing soils, undermining, and soil subsidence, there has been no damage to the pipe, and flow capacity is "as good as ever."

No other large-diameter water pipe can approach tar-enameled steel pipe in its strength to withstand high pressure from within and destructive forces from without; its leakproof joints; its ability to span washouts; its resistance to corrosion; and its maintenance of high flow capacity. And, remember, every length of steel pipe is hydrostatically tested after fabrication as required by AWWA specifications, usually to twice the required working pressure!

Bethlehem Steel is one of the nation's leading manufacturers of tar-enameled steel pipe.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation
*Export Distributor:* Bethlehem Steel Export Corporation

**BETHLEHEM STEEL**

BETHLEHEM STEEL

### 40-Ton Capacity Truck Crane

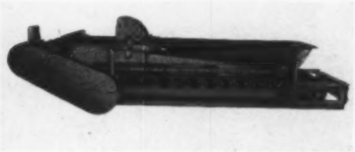
Featuring a revolutionary new outrigger system that adds tons of bonus capacity over ordinary outrigger systems, the new, air controlled, 40-ton capacity truck crane has been designed to strip easily and quickly for over highway travel, yet provide high capacity (40-tons rated) on the job. To accomplish this, the American 500 is equipped with a new outrigger system that permits substantial weight reductions in the carrier while providing a solid, steady foundation at five points, for the powerful, massive crane upper works and deep section boom needed for a crane of this capacity.

It features extremely deep center sections that swing out from the carrier, rather than sliding out, and which are locked into position. These sections are slightly longer than ordinary outriggers and are located almost directly under the rotating base of the machine, thereby, becoming an extremely steadying factor for the over the side operation. Two outriggers at the rear and one at the front of the machine add up to a five point system for a solid foundation that permits a full 360-deg swing with rated capacities which is 40% more operating arc than available with ordinary outriggers systems. There is less variation in stability as the crane rotates, with the new American system. **American Hoist & Derrick Co., CE-8, 63 S. Robert, St. Paul, Minn.**

### Belt Feeder

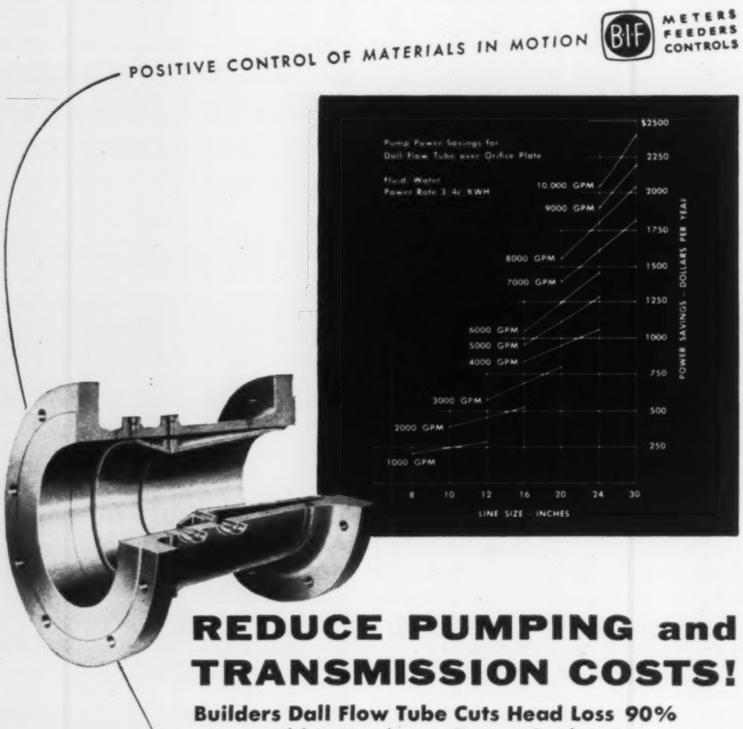
Offering a capacity range from 5 to 550-tph, as well as many other engineering and design features, the newly announced F-8 Belt Feeder has been designed for any application where a high degree of accuracy is necessary in feeding construction aggregates, ore, chemicals, or fertilizers. A pre-engineered, packaged unit, it is shipped completely assembled and ready for immediate installation in a reclaiming tunnel, in a track or truck dump hopper, beneath elevated bins, or in either a steel or wooden bulkhead.

Two drive arrangements are available, both assuring consistent accuracy and fine control of feeder output. Through the medium of a gearmotor and a roller chain drive, constant belt speed may be attained, with capacity controlled by a quadrant-type control gate equipped with a fine screw adjustment.



Capacity Range From 5 to 550-tph

As an optional, variable belt speed may be obtained through a variable speed reducer and roller chain arrangement, working in conjunction with a quick-adjusting quadrant gate having control settings in 1-in. increments. This permits adjustment of capacity by means of varying the gate opening, by alteration of the belt speed or by both means. Manual controls may be mounted on the reducer or remote controls may be installed at any point in a plant setup. Thus, a combination of two or more feeders offers total and proportional control of aggregate feed, when each is equipped with the remote control and variable speed reducer drive. **Barber-Greene Company, CE-8, 400 N. Highland Ave., Aurora, Ill.**



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Subsidiary—Barium Steel Corporation

## EQUIPMENT MATERIALS and METHODS

(continued)

### Four Wheel Drive Tractor

A NEW FOUR WHEEL drive, four wheel steer tractor called the Napco "Crab" is now being marketed. The unit gives approximately 45% more drawbar pull than a conventional tractor. This advantage is achieved without increasing the size or weight of the tractor. A three position selector allows the operator to choose front wheel steer, front and rear wheel steer, or oblique steer. Both front and rear wheels turn in the same direction. This, plus many other important features, allows the "Crab" to fill a big gap in the industrial, construction and agricultural tractor fields not already covered by conventional tractors. It is extremely versatile and will handle a tremendous variety of special attachments such as post hole diggers, backhoes, forklifts, loaders, plows, subsoilers, and dozers. The transmission allows the tractor to reverse without stopping or shifting gears. A special torque converter permits the "Crab" to furnish maximum horsepower at slow speeds and provide increased digging or lifting effort whenever required. It also has the following advantages: four wheel power steering, four speeds forward and four speeds reverse, 360-deg swivel seat, four wheel hydraulic mechanical PTO and an extremely short turning radius. **Napco Industries, Inc., CE-8, Seventh St.—North Lyndale, Minneapolis 11, Minn.**

Napco "Crab"

### Slide Gate

A NEW DESIGN OF slide gate for use as an unloading and shut-off valve in dry dust collector hoppers, storage bins, and transport lines is now available. The Ducon Type SL Slide Gate uses a unique gate actuating mechanism which offers four important advantages: it provides a positive gas-tight, dust-tight seal when closed; it is absolutely non-sticking be-

*(Continued on page 134)*

**Prestressed Concrete Tanks Show Big Savings**

**Maintenance Costs Cut By 75%**

Over a 50 year service life, a prestressed concrete tank will show a 75% saving in total maintenance costs over a steel tank of the same capacity. In today's economy, such a long range saving has tremendous appeal to municipalities and water companies throughout the world. When your tank requirements are in the planning stage, these calculated maintenance costs should be considered. Average yearly maintenance on a 3,000,000 gallon steel tank is estimated at $2500 per year at current prices. For a prestressed concrete tank, maintenance is negligible; however, occasional painting for color effect may be desired.

When the charges for servicing the initial cost plus relative maintenance allowances are plotted, the prestressed concrete tank will often show a lower out of pocket cost to the owner in less than 5 years. When these costs and their increases are extended for an expected service life of 50 years, the savings to the owner with prestressed concrete are enormous.

The prestressed concrete tank is also a good looking tank . . . it is inherently strong and extremely stable . . . it is designed and built for permanence.

And, 75% of the contract price is spent right in your local community . . . construction is done with materials and labor available locally.

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**THE PRELOAD COMPANY, INC.**
Jefferson Tower Bldg., 351 Jefferson, Dallas, Tex.
**THE CANADA GUNITE COMPANY, LTD.**
7325 Decarie Boulevard, Montreal 16, Canada

# EQUIPMENT, MATERIALS and METHODS

(continued)

cause it has a free sliding action with no close tolerances involved; and only one handle is used for operation and a minimum of effort is required to operate the handle. The major difference between the Ducon and other discharge valves of the slide-action type is the elimination of close-tolerance sliding surfaces. These close tolerances have been necessary in other gates to prevent dust from leaking out past the sliding surfaces. **The Ducon Company, Inc., CE-8, 147 E. Second St., Mineola, New York.**

## Road Finishing

A NEW SECTIONAL BRIDGING, especially designed for use on road building and bridge construction has been announced. Each scaffolding section is 12-ft long, 20-in. wide and 14-in. deep. Sections fasten together quickly to accomplish free spans up to 60-ft for the first time in the history of scaffolding, according to the manufacturer. Box girder construction eliminates side sway while reducing deflection to a minimum. This permits either side of scaffolding to be used by the workman, enabling him to reach any section of slab quickly, safely and economically. It is designed particularly for brooming, screeding and surfacing roadways, bridges and airport runways. The bridge has a design point loading of 400-lb. and a safety factor of 4. Because they combine lightweight formed aluminum channels with marine plywood skins and riveted construction, sections are light in weight, easy to transport and store. Rollers are also available. **Spartan Scaffolding Products, Inc., CE-8, South Gate, Calif.**

## Tripods

A NEW LINE OF industrial tripods has been developed that is said to meet the demand for a strong, rigid, yet light-weight support for handling large cameras or other heavy mechanisms efficiently and safely—with greater convenience and mobility. The units are made from high-strength, light-weight aluminum alloys, and are said to operate throughout a wide range of temperature and humidity. Elevator, pan heads and other accessories are designed as separate units that may be integrated with the tripod—so that the complete support for a given job need include only the units required for the job. Pan heads have anti-friction bearings on both horizontal and vertical axes, and are provided with brakes, gradually adjustable from any degree to complete immobility. **Quick Set Inc., CE-8, 8121 N. Central Park Ave., Skokie, Ill.**

## New Aluminum Grating

A NEW ALUMINUM GRATING, known as Gary Super Galok, has been introduced. A unique method of fastening the cross bars to the main bars prevents the cross bars from turning or coming loose. Instead, they project slightly above the main bars, providing a safe, slip-proof surface. The grating is made in all sizes from ¾-in. x 3⁄16-in. to 2¼-in. x 3⁄16-in., a standard mesh and close mesh on 4-in. centers or 2-in. centers. It is available with plain or serrated main bars. **Grating Division, Rockwell Standard Corp., CE-8, 1010 East Seventh Ave., Gary, Indiana.**

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## Literature Available

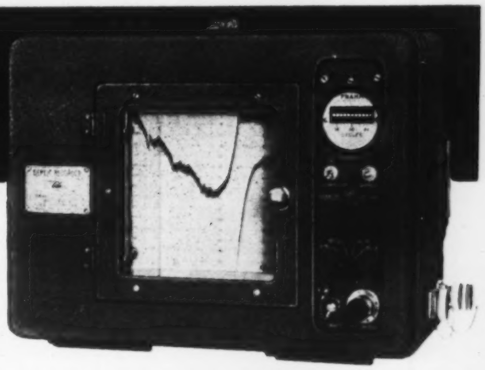
STADIUM & AUDITORIUM CONCRETING—Case histories of concreting problems encountered and successfully solved in stadium and auditorium construction are reported in the Reporter No. 12. Construction stories of 16 outstanding stadium and auditorium projects in this country and abroad cite the role played by Pozzolith in obtaining the desired handling properties of concrete during placement and to meet exacting requirements for concrete in the hardened state. Among the jobs included in this study are: The Dallas Memorial Auditorium and its unique lightweight concrete roof design; the placing of the reinforced concrete dome roof of the Albuquerque Civic Auditorium; and the thin shell concrete roof design at the University of Cincinnati Armory. These and 13 other case histories are dramatically illustrated by accompanying photographs. **The Master Builders Co., Division of American-Marietta Co., CE-8, 7016 Euclid Ave., Cleveland 3, Ohio.**

FORMING ACCESSORIES—According to this newly published brochure, screed supports are designed to take the heavy loads imposed by traveling vibrating screeding equipment. The holder consists of a 1-in. threaded rod to which is welded a cradle to hold the pipe screed. Threaded onto the rods is a nut which provides the adjustment. The bases are of two types: the metal base for use on structural steel members and the chair-type base for use on a plywood deck. The coil tie is one of the most economical and efficient form and spreader ties. Special lag screws, coil bolts, are threaded into the coils and removed for reuse after the concrete has set. Pictures and specifications are included. **Superior Concrete Accessories, Inc., CE-8, 9301 King St., Franklin Park, Ill.**

IRON CASTINGS—This the first time that ASTM has compiled and published as a single volume all of its standards relating to Iron Castings. The book has been brought out to meet an industry demand for a single volume to which foundry men could turn as a guide covering the materials used by them. Contained in the volume are 32 standards relating to pig iron, gray iron castings, cast iron pipe, malleable iron castings, welding rods and electrodes and general methods of test. Copies of this compilation, important to foundrymen, purchasing agents and metallurgists, may be obtained at $2.75 per copy. **American Society for Testing Materials Headquarters, CE-8, 1916 Race St., Philadelphia 3, Pa.**

VESSEL & MECHANICAL EQUIPMENT—Some of the equipment discussed in this 8-page, illustrated brochure are evaporators, rotary filters such as drum and retractable shell filters, dryers, heat exchangers, and flakers. **Goslin-Birmingham Mfg. Co., CE-8, Birmingham, Ala.**

Edo



**Model 255A SURVEY DEPTH RECORDER**

Edo Model 255A Survey Depth Recorder, designed expressly for underwater dredging and cable laying operations, employs an extremely narrow beam pattern (6° at −10 db) to obtain precise, detailed contour information. High operating frequency, 110 kc, minimizes penetration of silt or mud with the result that the recorder accurately pictures the soft bottom that is of concern in dredging.

Also available is Edo's Model 255B Survey Depth Recorder, with standard beamwidth (20° at −10 db), the ideal equipment for deep depth, penetration and general survey. With dual beam transducer, Model 255B can increase beamwidth to 40° at −10 db.

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## Literature Available

LATEX BINDER—Included in this brochure are paragraphs on the two main types of Latex Binder—Red Label and Yellow Label, their uses such as industrial and commercial flooring, concrete surface finishing, and roof coatings, and specifications. Also available are 4 pamphlets which discuss in more detail Surco, waterproof coating, terrazzo, and tile setting. **Surco International Corp., CE-8, 1330 W. Peachtree St. N.W., Atlanta 9, Ga.**

DIGESTER CIRCULATOR-MIXER—According to Bulletin 25-S-91, the Gaslifter Digester Circulator-Mixer not only eliminates the usual grease and scum blanket nuisance, but also accelerates the digestion of incoming "green" sludge by the thorough circulation of the digester contents. Gaslifters utilize the "airlift" principle, operate on compressed (4½-psig) digester gas, and are not subject to mechanical difficulties or fouling. **Walker Process Equipment Inc., CE-8, P.O. Box 266, Aurora, Ill.**

TWIN-POWER SCRAPER—The title of a new 24-page catalog (Form 554) featuring the Model TS-24 Euclid "Twin" Scraper, is "Designed for a new era in earthmoving." Graphically illustrated, with cut-a-way views and diagrams of major components as well as "at work" pictures from a variety of jobs, the booklet covers all features of design, operation and performance of the scraper. Of special interest is a section devoted to "Twin-Power"—what it is, how it was developed, and what it means in terms of increased productive capacity. **Euclid Division, General Motors Corp., CE-8, Cleveland 17, Ohio.**

AERATION BLENDING—A 16-page technical bulletin, B-2, describing the Airmerge System for the exact blending of dry pulverized materials is now available. The eight illustrated sections discuss the complete operation, including installation, blending problems and explanation of how the system's various components function. Photographs and cut-away line drawings show how dry materials are thoroughly homogenized by combining quadrant blending and pulsated aeration. **Fuller Co., CE-8, Catasauqua, Pa.**

SAFETY RELIEF VALVES—Detailed information for the ready selection and sizing of all nozzle safety relief valves is included in a new specifications catalog. The brochure restricts itself to valves applicable to process piping. The 44-page booklet includes information both Standard and Balanseal Bellows varieties of valves; a complete data section containing sizing factors and formulae; and nozzle capacity charts for air, water, gas and steam and dimension and weight tables. **Farris Engineering Corp., CE-8, 709 Commercial Ave., Palisades Park, N.J.**

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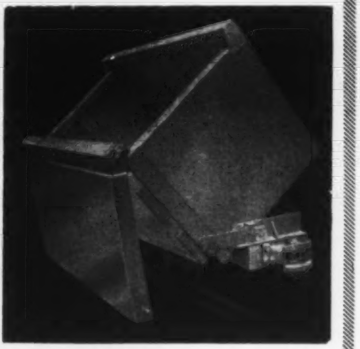

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- **Rocker Dump Car** Ideal for sticky muck or wet concrete. 1 cu. yd. capacity. 24" gage.
- **Tunnel Car.** Box body is removable and may be hoisted to surface to be dumped into truck. ½ to 2 cu. yd. capacity. 18" or 24" gage.

FREE Bulletin No. 18 shows car details; No. 21 illustrates Automatic Coupler.

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TIDE GATES

Fig. B-68, Type M
(CIRCULAR)

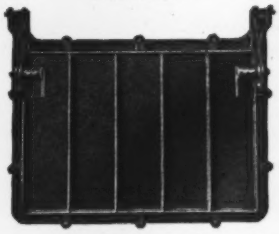

Fig. B-61, Type MM
(RECTANGULAR)

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# From the MANUFACTURERS

**WELDING ELECTRODES:** A critical weldment in the petroleum refining industry has become the first application for the "Plate-Mate" welding electrodes introduced by Lukens Steel Co., which announced it will furnish both the welding rods and the alloy steel plate to be used in catalytic cracker cyclones being fabricated by Union Boiler & Manufacturing Co., Lebanon, Pa. . . . **NEW MANUFACTURING RIGHTS:** The Acker Drill Co. has announced the acquisition of exclusive manufacturing rights of the Denison Core Barrel. The ability of the tool to obtain undisturbed samples from sand, hard clays, silt and other difficult cohesive soil conditions accounts for its acceptance by soil engineers, foundation designers, and consultants . . . **FORK LIFT TRUCKS:** The Brazilian government has placed an order for 572 industrial fork lift trucks from The Yale & Towne Manufacturing Co. This is the largest single export order for fork lift trucks ever placed with an American materials handling equipment manufacturer, the company said . . . **NEW REGIONAL OFFICE:** The establishment of a new regional office in Denver, Colo., has been disclosed by G. Donald Kennedy, president of the Portland Cement Association . . . **FINANCING PLAN:** Armco Drainage & Metal Products, Inc., has announced a new financing plan for purchasers of its line of prefabricated steel buildings . . . **NEW PLANT:** The Flintkote Co. has opened a new multi-million dollar Insulrock producing plant at North Judson, Ind., to serve Chicago and the Mid-Western area . . . **COMPUTER SERVICE:** Newly opened in Arlington, Va., is the Computer Services Div. of the Council for Economic & Industry Research, Inc., which is said to be the country's first independent, commercial computer service equipped with an International Business Machines Corp. large-scale computer . . . **INCREASED EARNINGS:** Net income of The Foundation Co. of New York in 1957 totaled $170,944, 151% increase over the $68,047 reported in 1956 . . . The A.M. Byers Co. has reported that net profit after taxes for the January-February-March period was $37,050 on net sales of $5,302,487 . . . It has been disclosed that income from operation of properties during the first half of fiscal 1958 reached the highest level in the 60-year history of Tishman Realty & Construction Co., Inc. . . . **REPRESENTATIVE APPOINTED:** Fischer & Porter Co., Hatboro, Pa., manufacturer of complete process instrumentation, has appointed Martig's Inc., 5741 North East Glisan St., Portland, Ore., as their representative for all of Oregon and the counties of Cowlitz, Skamania, Clark, and Klickitat in Wash. . . . **APPOINTMENT:** Ross E. Schofield has joined Kerrigan Iron Works, Inc. as Southwest Representative with headquarters at 1915 South Shepherd Drive, Houston, Tex.

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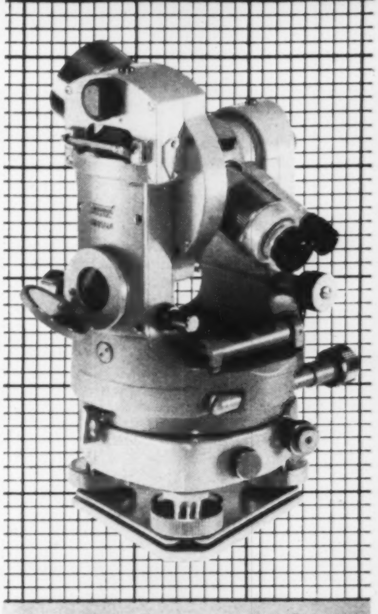

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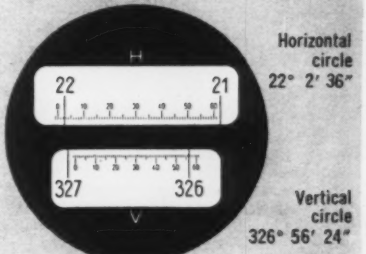

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# PROCEEDINGS AVAILABLE

## July

Journals: Engineering Mechanics, Structural, Surveying and Mapping, Sanitary.

**1692. Cylindrical Bending of Elastic Plates, by S. J. Medwadowski and K. S. Pister. (EM)** The effect of shear deformation on strong cylindrical bending of an elastic plate under uniform transverse load is considered. The problem is solved and graphs are given, from which numerical results are obtainable. The solution is compared with the corresponding result of the classical theory.

**1693. Dynamic Elasto-Plastic Response of Rigid Frames, by Frank L. DiMaggio. (EM)** Using expansions in terms of modes, the response of rigid frames to a concentrated force at the knee is determined. For two-hinged frames and a linearly decaying forcing function, two detailed numerical examples are presented. It is concluded that good approximations are obtained by considering only one elastic and one elastic-plastic mode.

**1694. Design of Long Reinforced Concrete Columns, by Bengt Broms and Ivan M. Viest. (ST)** A design procedure involving the strength of a short column, the eccentricity determined from an elastic analysis and a reduction coefficient is presented. The procedure may be used either at working or at ultimate load level.

**1695. Structural Dynamics in Earthquake-Resistant Design, by John A. Blume. (ST)** Strengths, rigidities, and ultimate earthquake resistances of traditional and modern buildings are compared. Research using four actual earthquake records provides shear values for 16 20-story "buildings" with various damping and stiffness characteristics.

**1696. Earthquake Design Criteria For Stack-Like Structures, by John E. Rinne. (ST)** This paper indicated the response of uniform and tapered stacks and stack-like structures to earthquake ground motion, develops some criteria for shears and moments for design, and compares these with criteria suggested or specified by others.

**1697. Highway And Bridge Surveys: Preliminary Surveys, Progress Report of the Committee on Highway and Bridge Surveys. (SU)** The preliminary survey for a highway is a detailed study of one or more feasible routes, resulting in a paper location which defines the line for the subsequent location survey. Mapping methods and critical factors affecting the selection of alignment are examined.

**1698. Highway and Bridge Surveys: Location Survey, Progress Report of the Committee on Highway and Bridge Surveys. (SU)** The location survey fixes the proposed highway's centerline on the ground and includes the procurement of field data necessary for complete design. Procedures for transferring the paper location to the ground are described as well as the manner of securing information on critical features of the location.

**1699. Surveying for Richard I. Bong Air Force Base, by Peter A. Machinis. (SU)** The surveying problems in the development of the Richard I. Bong Air Force Base although numerous were not of an unprecedented nature. Advance, coordinated planning based on a combination of new and old established surveying techniques produced the desired results.

**1700. Photogrammetric Developments for Highway Engineering, by R. H. Sheik. (SU)** Progress made in gaining the confidence of engineers and contractors in aerial photogrammetry can be maintained by the engineer and the aerial photogrammetric contractor insisting on accuracy.

**1701. Gas Transfer To and From Aqueous Solutions, by Thomas R. Camp. (SA)** This paper reviews the development of recent advances in the theory of gas transfer, with an examination of various items. Emphasis is put on the need for more research on the subject.

**1702. Effects of Mechanics of Flow on Corrosion, by Amilcar J. Romeo, Rolf T. Skrinde, and Rolf Eliassen. (SA)** This paper presents fundamental hydraulic concepts as applied to corrosion and the rate of interacting chemicals in flow over plates, rotating disks, and through pipes.

**1703. Forced Circulation of Large Bodies of Water, by Thomas M. Riddick. (SA)** In 1956 a floating aerator was put in service at the Ossining, N. Y. municipal water collecting reservoir. Results included completely breaking reservoir stratification, and oxidation and precipitation of iron and manganese, among others.

**1704. An Introduction to Solar Distillation, by Tim de Jong. (SA)** This paper presents a study and results of experiments on the production of potable water with solar energy on three pilot plants in Iran. Effects of geographical location, size and shape of plants, and descriptions of various plants and methods of distillation on the actual production of the pilot plants are explained with charts and tables.

**1705. Sanitary Engineers: The Need and the Securing, by Frank A. Butrico and Mark D. Hollis. (SA)** More, better, and differently qualified sanitary engineers are required. They should be attracted by a more adequate public relations campaign, and should be financially supported at the academic training levels especially in the undergraduate years.

**1706. Limit Analysis of Simply Supported Circular Shell Roofs, by M. N. Fialkow. (EM)** Plastic collapse of a partial circle cylindrical shell supported at each end with the longitudinal edges free is investigated for the case of uniform radial loading. The principles of limit analysis applicable to a plastic-rigid structure are utilized to develop upper and lower bounds for the collapse pressure.

**1707. Wind Forces on Structures: Introduction and History, by J. M. Biggs. (ST)** This paper is an introduction to a group of papers prepared by the Committee on Wind Forces of the Structural Division. The papers are Proceedings Papers 1707, 1708, 1709, 1710, 1711 and 1712.

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**1708. Wind Forces on Structures: Nature of the Wind, by Robert H. Sherlock. (ST)** Recommendations are given for the one-minute-average wind velocity at a height of 30 feet as the basic velocity of reference in different parts of the country and for different height zones. The origin of strong winds, extratropical cyclones, hurricanes, and tornadoes are treated.

**1709. Wind Forces on Structures: Fundamental Considerations, by Glenn B. Woodruff and John J. Kozak. (ST)** This paper concerns forces on structures and structural elements caused by wind. The variables which determine magnitude of aerostatic and aerodynamic forces are examined. Pressure distribution and drag and lift coefficients for certain elementary shapes are shown.

**1710. Wind Forces on Structures: Forces on Enclosed Structures, by Thomas W. Singell. (ST)** This paper analyzes the work of past and present investigators and correlates data relating to shape coefficients for various building shapes. Included is a series of tables from the Swiss Building Code.

**1711. Wind Forces on Structures: Plate Girders and Trusses, by W. Watters Pagon. (ST)** This paper presents such indications and conclusions as can be drawn at this time, of knowledge from available wind tunnel tests on plate girder and truss bridges, with open or closed deck, and for towers, antennae and similar structures.

**1712. Wind Forces on Structures: Structures Subject to Oscillation, by F. B. Farquharson. (ST)** Determination of wind forces on a structure is basically a dynamic problem. This paper is devoted to that portion of the problem involving structures which respond dynamically to the imposed wind forces.

**1713. Highway and Bridge Surveys: Introduction to Bridge Surveys and Reconnaissance Survey, by Milton O. Schmidt, Chmn. (SU)** The progressively longer span bridge structures now being built have made mandatory the use of accurate construction controls and use of geodetic equipment by trained personnel. Part B of the proposed manual deals with bridge surveys, and Chapter V describes the reconnaissance survey for a large bridge.

**1714. Fringe Area Sewerage Problems, by John E. Kiker, Jr. (SA)** The paper reviews the problems and some of the means of solving fringe area sewerage problems. The relative merits of septic tanks, package plants and oxidation ponds are considered from the standpoint of construction and operation.

**1715. Design Details for Individual Sewage Disposal Systems, by Harrison A. Martin. (SA)** Design procedures, simplification of design methods and comment on design of septic tank systems are presented. Some standardization is provided and methods are examined.

**1716. Precise Surveys for Mackinac Bridge, by R. M. Boynton. (SU)** A description is given of surveying problems involved, equipment and methods used to establish a major triangulation net on land, and vertical control across approximately four miles of water.

**1717. Controlled Submergence of Pittsburgh's Deep Sewers, by J. F. Laboon. (SA)** Design features of Pittsburgh's thirty miles of tunnel sewers now under construction by the Allegheny County Sanitary Authority, and proposed procedures for operation of the system under controlled submergence are described in this paper.

**1718. Effective Width of Thin Rectangular Plates, by Morris Ojalvo and Frederick H. Hull. (EM)** The behavior of simply supported rectangular plates subjected to edge compression in one direction is investigated by means of load-shortening tests. The data are presented by non-dimensional curves of effective width versus average unit shortening.

**1719. Bending of Elastically Supported Rectangular Plates, by Melvin Zaid and Marvin Forray. (EM)** The problem of bending of a rectangular plate, elastically supported on variable rigidity beams, subjected to a transverse loading or temperature gradient is solved in this paper. Specific combinations of support are examined, and a detailed solution is given for a square plate with one edge free.

**1720. Education in Surveying and Photogrammetry in Europe, by G. Gracie and H. Karara. (SU)** This paper presents the formal education in surveying and photogrammetry offered in a number of western European countries. The various university undergraduate courses in surveying and photogrammetry and the graduate studies and degrees are examined.

**1721. Discussion of Proceedings Papers 1023, 1302, 1304, 1440, 1510, 1519, 1567. (ST)** A. W. Hendry and L. G. Jaeger closure to 1023. Stewart Mitchell and Gerald F. Borrmann closure to 1302. Carl E. Ekberg, Jr., Rene E. Walther, and R. G. Slutter closure to 1304. John M. Hayes corrections to 1440. J. J. Hromadik on 1510. W. J. Jurkovich on 1519. Harry Posner corrections to 1567. William S. Walker and Joseph T. Kolibal on 1567.

**1722. Analysis of Finite Beams on Elastic Foundation, by Denos C. Gazis. (ST)** The analysis of bending of finite beams on elastic foundation, under the action of an arbitrary distribution of lateral loads, is accomplished by an iterative procedure analogous to the Hardy Cross method for the analysis of continuous beams and structural frames.

**1723. The Behavior of One-Story Brick Shear Walls, by Jack R. Benjamin and Harry A. Williams. (ST)** This paper gives the results of an investigation of the effectiveness of unreinforced brick masonry walls to resist shear forces applied in the plane of the wall. Some approximate relationships are suggested as a means of predicting the behavior of such walls.

**1724. Discussion of Proceedings Papers 1604. (EM)** A. Hrennikoff corrections to 1604.

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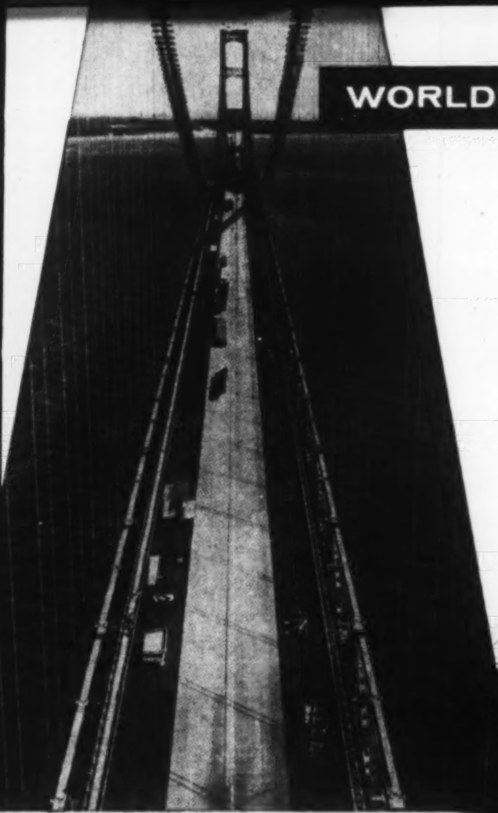

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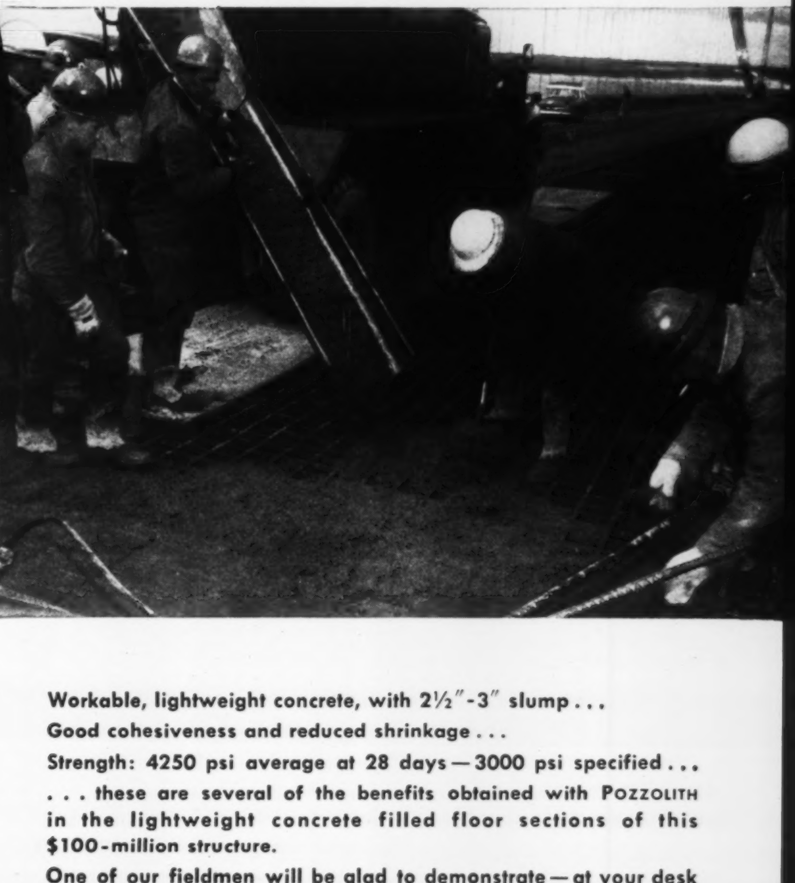

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